COMMERCIAL NEW CONSTRUCTION PROGRAM

Final Results Report

City of Council Bluffs Police Headquarters

Council Bluffs, IA

March 31, 2017
4017072

Prepared for

MidAmerican ENERGY

877.939.1874
midamericanenergy.com

and

Black Hills Energy

785.832.3932
blackhillsenergy.com

by

THE WEIDT GROUP®

877.938.1588
theweidtgroup.com

This page intentionally left blank

Table of Contents

Introduction 2
Energy Analysis Process 3
Project Summary 5
Selected Mechanical System Results 8
Integrated Utility Savings 10
Bundle Results 15
Utility Incentive 21
Verification 24
Strategy Descriptions and Results 25
Appendix A. Baseline Building Description 62
Appendix B. Building Characteristics 64
Appendix C. Detailed Results 77
Appendix D. Project Participants 86

Introduction

This Report is designed to assist the Owner and Project Team in making energy-related decisions about building design. In the Preliminary Results Meeting, the group selected an HVAC system and bundled a series of energy conservation strategies into three bundles. This report updates those results with the building's specific geometry and characteristics.

While the virtual building model estimates overall energy consumption, it is primarily designed to forecast savings, much like forecasting the savings from buying a fuel-efficient car. Energy consumption and savings forecasts are based on assumptions about occupancy, operations, weather, and other factors. As with a car, however, changes in use or operation affect the absolute value of savings, but the relative value—percentage saved, for example—compared to the less fuel efficient option, will still be valid. In the end, it is up to the Owner/operator to use and operate the building effectively in order to realize savings.

This program should not be construed as correcting or overriding previous decisions or recommendations of the Project Team. The program is analytical in nature, using tools and methods not normally part of the customary design contract. The Project Team remains responsible for the implementation of strategies and final engineering of systems, as well as for determining costs of various strategies.

The process follows a clear methodology of information gathering, collaboration, and analysis in an integrated setting of two formal meetings. The Owner, Project Team, and The Weidt Group work together to understand how the building will use energy and where cost-effective savings can be realized, through design. These are the steps, with the current stage shown in bold.

1. Preliminary Energy Analysis
2. **Final Results—TODAY**
   - **Review building design**
   - **Review baseline results**
   - **Review high potential strategies**
   - **Review and revise Bundles**
   - **Owner and design team select a bundle**
3. Verification
   - Construction Documents review
   - On-site verification of strategies

Energy Analysis Process

DOE-2 Energy Model

The Weidt Group analyzes energy solutions using DOE-2.2, a building simulation program. The program performs thermal and luminous calculations on an hour-by-hour basis, using typical yearly climatic data, to determine the building's energy loads and system requirements.

The Weidt Group gathers building description data and assumptions from the Owner and Project Team to construct the model. Some of the customized operating assumptions include the following.

- Building geometry
- Building base envelope construction
- Building programming and operation
- Base mechanical system design
- Base lighting system design

The energy models are simulated using the Council Bluffs, IA DOE-2.2 Typical Meteorological Year (TMY) weather file.

This energy model is intended for comparison of relative differences in net energy use for various design alternatives, compared to a baseline condition; it is not intended for system design and/or equipment selection. In addition, the actual energy use of this building will be different from the DOE-2.2 simulations because there will be differences in the weather, operating parameters, occupancy, and other circumstances not anticipated in the model. Given those qualifications, however, this model offers energy savings estimations as good as any other means available for a building that has not yet been built.

Baseline Model

The Baseline model provides a benchmark for comparison of alternatives. The sole purpose of the Baseline is to establish a starting point for program administration. The Baseline uses building characteristics provided by the Project Team, default operating characteristics representative of this building type, and minimum performance criteria for building components or systems based upon the prevailing energy code. A Protocol has been established for Baseline criteria.

Building Characteristics

For this modeling program, a number of building design characteristics, owner operating schedules and representative utility energy cost tariffs are assumed. This

document includes the modeling assumptions provided by the Owner, Project Team, and The Weidt Group. A summary of this information can be found in the Appendices.

Incremental Costs and Payback Analysis

The Weidt Group provides default values. Default costs values are based on an assessment of values provided to us on past projects. The Weidt Group requests that the design team review these values and provide project specific costs whenever more specification is necessary. The Weidt Group also requests the design team's cost development assistance for strategies where default values are not available.

Modeling of Specific Strategies

At the Preliminary Results Meeting, representatives of the Owner, Project Team, and The Weidt Group reviewed and edited a list of energy savings strategies, so as to bracket a range of acceptable design solutions. The strategy list can be found beginning on page 26 of this Report. By running a range of solutions, the model allows comparative analysis between envelope, mechanical and lighting system energy conservation alternatives.

Isolated Strategy Review

The Weidt Group simulates each strategy individually and compares results to the Baseline model to illustrate the impact of each strategy alone. It is common for individual strategies to impact the base models by less than 10%. However, selecting 15 strategies, each with an average value of 2% to 3%, might result in an annual building energy cost performance on the order of 30% to 40% better than the baseline. It is important to understand that the results are not always 100% additive; two strategies that save 2% alone, may not save 4% together. More likely, they will save 3.2% to 3.8% when combined.

Changes to the Model

The following changes were made to the model as a result of discussions during the Preliminary Results Meeting, as well as further discussion with the Project Team following the meeting.

- Building characteristics were updated
- Geometry was updated

Note that the above changes have modified the results for Baseline and all the strategies. The revised results for all the strategies are included in Appendix C.

Project Summary

The following table is a project summary. This information is based on a review of the design documents and conversations with the Project Team. Additional building characteristics are listed in the Appendices.

Building Summary		
Location	Council Bluffs, IA	
Space Asset Types	Area	Number of Stories
Office	50,905 ft²	2
Sally Port, Maintenance	4,670 ft²	1
Total	**55,690 ft²**	**2**
Systems Summary		
Envelope	Slab-on-grade, masonry veneer structure	
Glazing	Punched windows, curtainwalls	
Lighting	LED	
Plug Loads	Typical	
Service Water Heating	Gas-fired condensing unit	
Hours of Operation	Most of the lower floor occupied 24/7. Other areas occupied typical office hours.	
HVAC Scenario	Water-to-water ground-source heat pump system supplemented by gas-fired condensing boilers and air-cooled chiller, ventilation air provided by DOAS unit; K9 served by packaged single zone; Maintenance served by gas-fired makeup air units	
Utilities		
Electric Utility	MidAmerican Energy Company	
Gas Utility	Black Hills Energy	
Schedule		
Construction Documents Complete	04/21/2017	
Construction Start	06/01/2017	
Occupancy	12/07/2018	
Other Notes		

Baseline Operation Assumptions

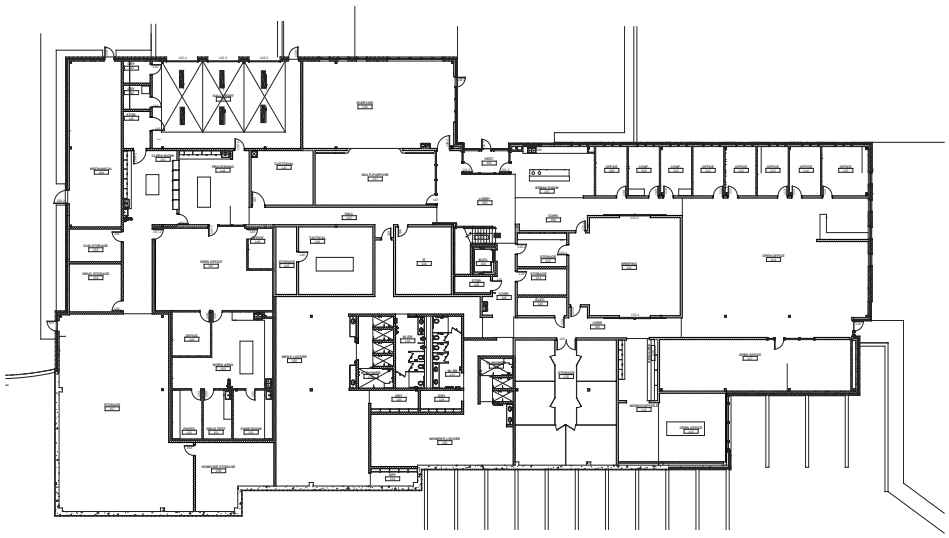
The baseline model assumes the following design parameters as well as accompanying operational assumptions, based upon transmittal information from the Owner and Project Team.

Space Type	Floor area	% area	Baseline lighting power (W/sf)	Base equipment/ plug load (W/sf)	System air flow (CFM/sf)	Annual lighting full load hours	Annual scheduled fan hours
Private office	4,600	8%	1.11	1.20	1.06	3,100	4,500
Open office	8,800	16%	0.98	1.20	0.84	4,300	4,500
Conference	1,600	3%	1.23	0.50	1.47	2,900	4,500
Briefing/Multi-Purp/Tactica	2,400	4%	1.23	0.50	0.97	6,700	8,760
Community room	1,700	3%	1.23	0.50	1.49	2,900	4,500
IT Equipment	400	1%	0.98	12.00	2.92	7,200	8,760
Corridor	2,900	5%	0.66	0.10	0.75	3,700	4,500
Lobby	2,100	4%	0.90	0.25	2.24	7,700	8,760
Storage	9,700	17%	0.63	0.10	0.76	3,000	4,500
Mech/elec	2,500	4%	0.95	0.20	0.64	3,500	4,500
Restroom	1,100	2%	0.98	0.10	0.65	3,500	4,200
Crime lab	1,200	2%	1.28	3.00	1.08	5,500	4,200
Exercise	1,400	3%	0.72	0.10	0.90	4,400	8,760
Sally Port	1,600	3%	0.19	0.10	1.05	8,700	8,760
Locker Room & Shower	4,300	8%	0.75	0.50	0.50	5,400	8,760
Break room	700	1%	0.65	0.20	1.48	7,300	8,760
Private Office 24/7	1,700	3%	1.11	1.20	1.05	6,600	8,760
Open office 24/7	4,800	9%	0.98	1.20	0.84	8,700	8,760
Corridor 24/7	1,100	2%	0.66	0.10	0.69	7,700	8,760
Conference 24/7	300	1%	1.23	0.50	1.35	6,700	8,760
Storage 24/7	700	1%	0.63	0.10	0.85	6,600	8,760
Total	**55,600**	**100%**					
Average			**0.88**	**0.73**	**0.94**	**4,900**	**6,100**

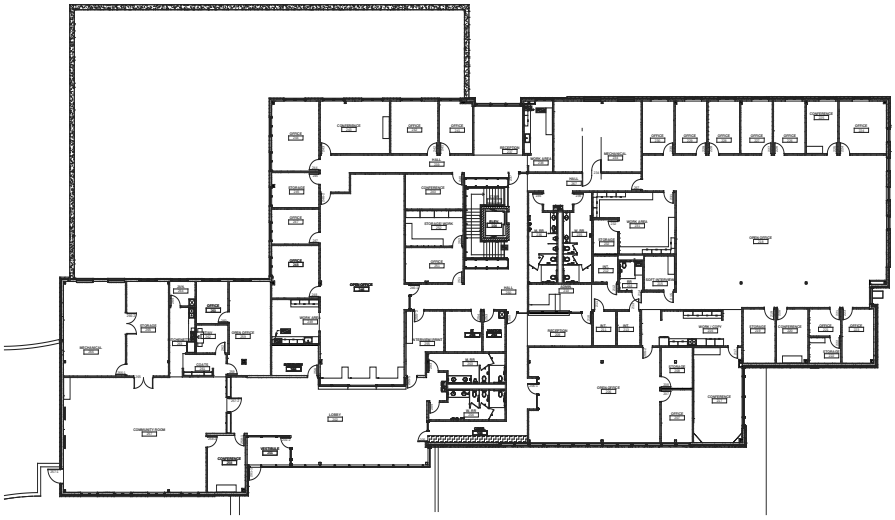
Additional mechanical design assumptions may be found in the Appendices of this Report. The Baseline model also assumes the following mechanical design/ operating parameters.

- Building common areas operates in a setback mode during unoccupied hours in which thermostats in conditioned spaces are reset downward in winter and upward in summer
- Ventilation unit outside air dampers are assumed to be closed at night, and fans can cycle on to maintain nighttime temperature settings
- Central supply fans incorporate “discharge air reset” control, which allows the discharge air set point to modulate according to the warmest zone in order to reduce cooling and reheat energy

Building Plans



Lower level



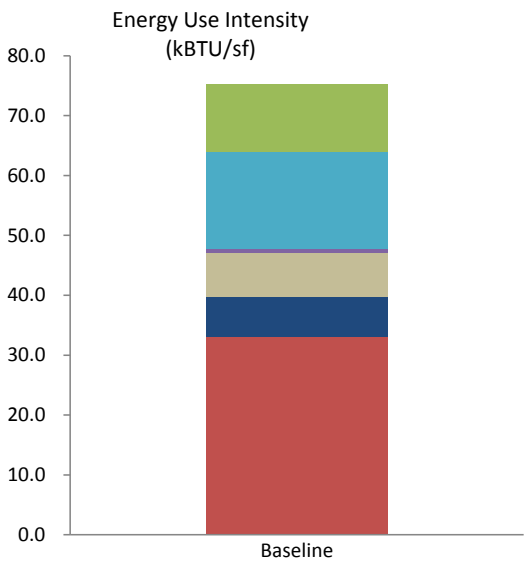
Upper level

Selected Mechanical System Results

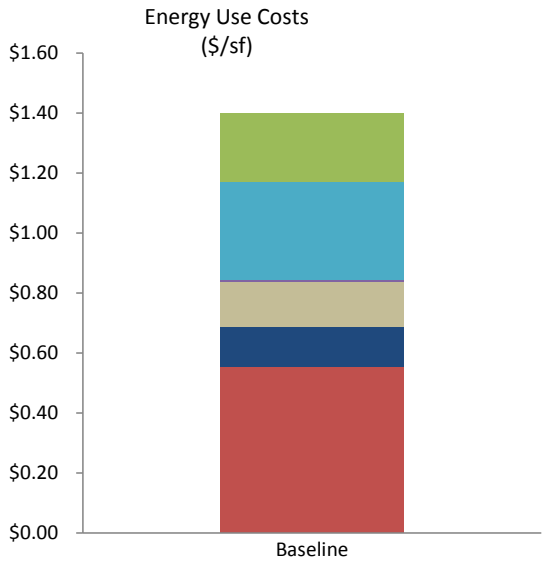
This page identifies the projected energy consumption of this building with VAV water-to-water heat pump with supplemental gas boiler and air-cooled chiller, the mechanical system selected in the first meeting. The charts below show the Baseline model breakdown of annual energy consumption and energy cost.

The annual energy use prediction for the baseline model is 75.2 kBtu/sq ft and the energy cost is $1.40/sq ft. Total energy cost is approximately $77,900 per year at baseline.

Energy Use Intensity and Energy Costs of Proposed Mechanical Systems



	Baseline
Equipment	11.3
Lighting	16.1
SWH	0.7
Fans & Pumps	7.5
Cooling	6.5
Heating	33.1
Total	75.2



	Baseline
Equipment	$0.23
Lighting	$0.33
SWH	$0.01
Fans & Pumps	$0.15
Cooling	$0.13
Heating	$0.55
Total	$1.40

Key Observations

- The Btu Energy use is the energy delivered to the building, not including the energy for generation and transmission of electricity or gas
- Heating is the dominant “energy” (Btu), but heating costs are much less proportionally than electrical costs for equipment, lights, fans/pumps, and cooling

This page intentionally left blank

Top Integrated Utility Savings

This table shows Whole Building results for individual strategies or groups of strategies to show the best opportunities. Dollar savings affect payback, and savings accrue every year of a building's life. Strategies are defined on page 26, and in selected Appendix sections starting on page 62.

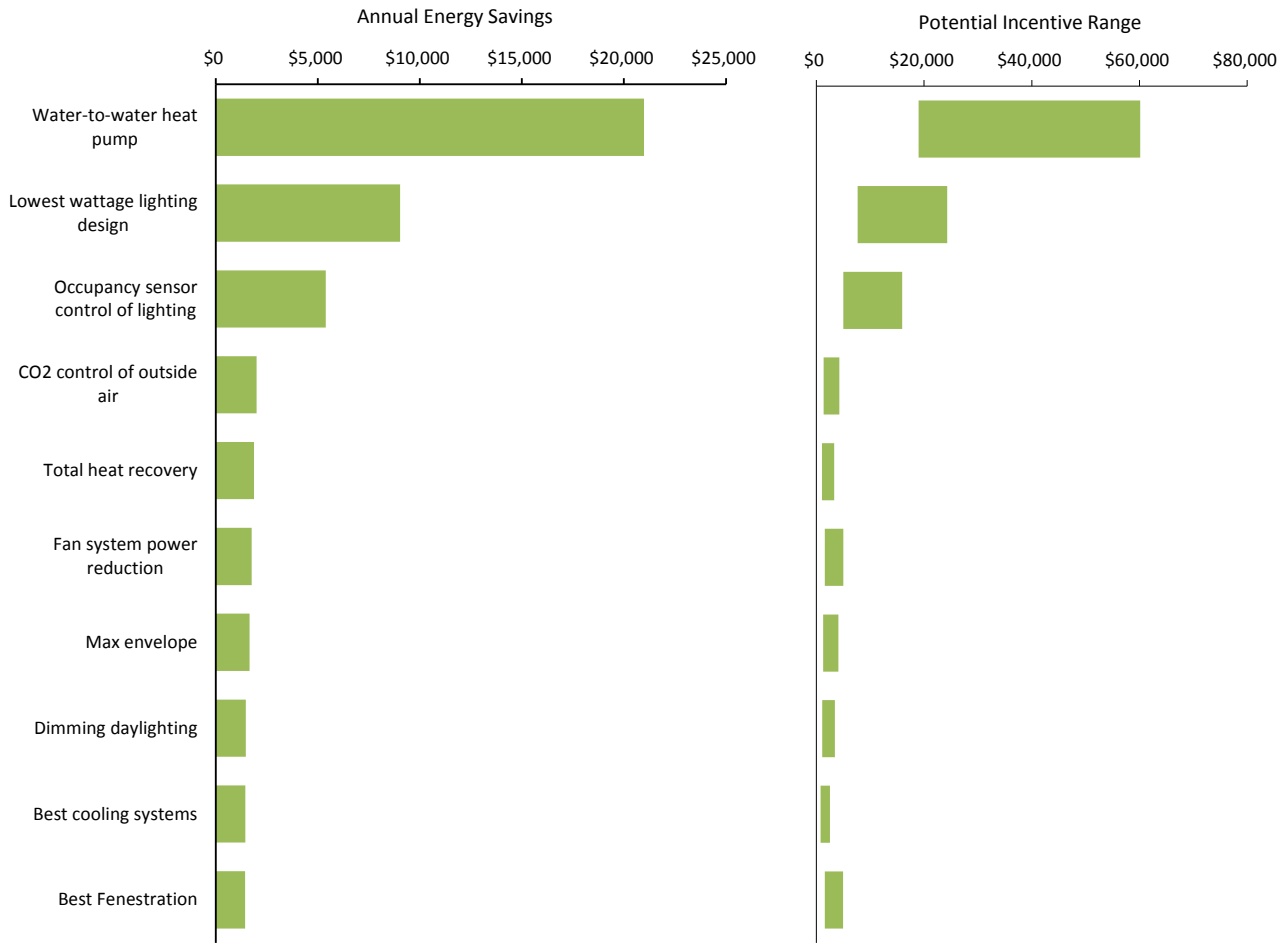
Strategy Description	How does this strategy save energy?	Annual Energy Savings	Included in Bundles
Water-to-water heat pump	Heating and cooling energy are decreased by changing to a system that exchanges heat with the ground	$20,986	1, 2, 3
Lowest wattage lighting design	Lighting wattage is saved by reducing light level or increasing lighting system efficiency	$9,028	3
Occupancy sensor control of lighting	Lighting energy is saved by turning lights off when applicable spaces are empty	$5,388	2, 3
CO2 control of outside air	Heating and cooling energy are reduced by lowering ventilation rates during times of reduced occupancy	$2,001	3
Total heat recovery	Heating and cooling energy are reduced by recovering heat from building exhaust air	$1,871	1, 2, 3
Fan system power reduction	Building fans energy is reduced relative to maximum allowed by Appendix G	$1,762	3
Max envelope	Heating and cooling load is reduced by increasing insulation levels	$1,654	1
Dimming daylighting	Lighting energy is saved by dimming lights automatically in response to daylight	$1,472	1, 2, 3
Best cooling systems	Cooling energy is reduced by an increased system efficiency	$1,443	
Best Fenestration	Heating and cooling load is reduced by improved window characteristics	$1,439	

Hourly Whole Building analysis allows us to present integrated results. Individual conservation and efficiency strategies can affect more than one fuel source. For example, a more efficient lighting design produces less heat. This reduction in interior heat gain reduces cooling energy needs. If cooling energy is produced by electricity, those savings are integrated into the Annual Dollar Savings above. However, that more efficient lighting may cause a need for more heating energy in the winter. If the heating energy came from gas, the additional heating cost would be reflected in the values above.

The same methodology is used throughout this Report. A positive Annual Dollar Savings means the offsetting changes between electric consumption, gas consumption and central or district energy consumption result in a savings.

This figure provides a visual comparison of the savings potential of the top integrated utility savings strategies.

Top Integrated Savings Opportunities



Key Observations

- Ground-coupled water-to-water heat pump strategy results in the highest energy savings

Bundle Modeling

Upon review of the results of the isolated strategy analysis, the Owner and Project Team created three bundles of strategies for final modeling. The three bundles were developed using the following the guidelines.

- Bundle 1 is the current proposed design
- Bundle 2 builds upon Bundle 1 with additional strategies with reasonable paybacks
- Bundle 3 builds upon Bundle 2 with additional strategies with reasonable paybacks

The following lists the composition of strategies in each bundle.

Bundle 1 includes a number of strategies that improve the building beyond a baseline level.

- Upgrade to R-16 wall assembly
- Upgrade to R-24 roof assembly
- Design glazing (Unit U-Factor 0.45, COG U-Factor 0.31, SHGC 0.29, Visible Trans. 0.41)
- Dimming daylighting controls with LEDs controlling electric lights in total area of 12,210 sf
- Occupancy sensor control of lights in corridor (2,878 sf), lobby (2,148 sf), crime lab (1/3 level) (1,193 sf) and corridor 24/7 (1,085 sf)
- Building wide 30% lower than ASHRAE 90.1-2010 (55,690 sf at 0.62 W/sf) – please refer to the table on page 14 for space-by-space LPD details
- Condensing gas boiler at 95% efficiency
- Water-to-water heat pump, ground coupled system (16.6 EER, 3.70 COP) serving VAV air handlers with supplemental condensing gas boiler (95% efficiency) and air-cooled chiller (1.26 kW/ton)
- Fan system power at 1.11 bhp/1000 cfm
- VFD on heating pump
- VFD on cooling pump
- Carbon monoxide sensor control of garage vent fans
- Total heat recovery system (70% sensible and latent), gathers at least 90% of the building exhaust air volume- applicable to all VAV air handlers
- 95% service water heating efficiency

Bundle 2 adds or modifies the following strategies, compared to Bundle 1.

- Upgrade to R-20 wall assembly
- Upgrade to R-30 roof assembly

- Vacancy sensor control of lights in private office (4,600 sf), open office (8,800 sf), conference (1,600 sf), briefing/multi-purp/tactical (2,400 sf), community room (1,700 sf), IT equipment (400 sf), lobby (2,100 sf), storage (9,700 sf), mech/elec (2,500 sf), restroom (1,100 sf), crime lab (1,200 sf), exercise (1,400 sf), locker room & shower (4,300 sf), break room (700 sf), private office 24/7 (1,700 sf), open office 24/7 (4,800 sf), conference 24/7 (300 sf), storage 24/7 (700 sf)
- Building wide 40% lower than 90.1-2010 (55,690 sf at 0.53 W/sf)
- Fan system power at 0.99 bhp/1000 cfm

Bundle 3 adds or modifies the following strategies, compared to Bundle 2.

- Upgrade to R-40 roof assembly
- Manual dimming of lights in break room (690 sf)
- Building wide 50% lower than 90.1-2010 (55,690 sf at 0.44 W/sf)
- Supplemental air-cooled chiller at 1.20 kW/ton
- Upgrade to exceeding premium efficiency supply return fans
- Fan system power at 0.87 bhp/1000 cfm
- Upgrade to exceeding premium efficiency pump motors
- Chilled water pump system power at 19.8 W/gpm
- Hot water pump system power at 17.1 W/gpm
- CO2 control of outside air- applicable to all VAV air handlers

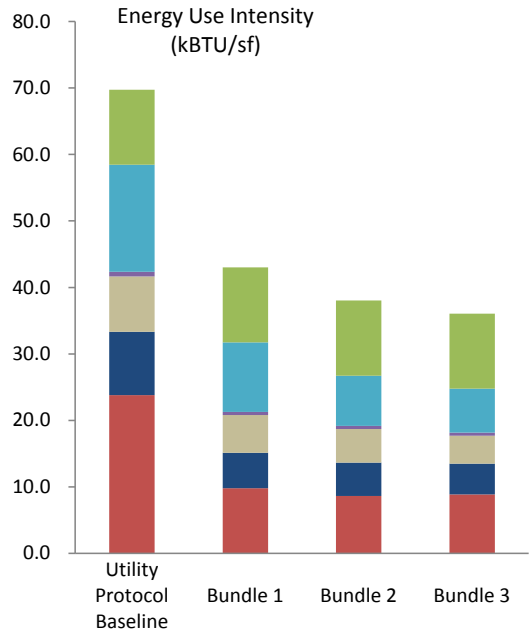
Space Type	Baseline	Bundle 1	Bundle 2	Bundle 3
Private office	1.11	0.78	0.67	0.56
Open office	0.98	0.69	0.59	0.49
Conference	1.23	0.86	0.74	0.62
Briefing/Multi-Purp/Tactical	1.23	0.86	0.74	0.62
Community room	1.23	0.86	0.74	0.62
IT Equipment	0.98	0.69	0.59	0.49
Corridor	0.66	0.46	0.40	0.33
Lobby	0.90	0.63	0.54	0.45
Storage	0.63	0.44	0.38	0.32
Mech/elec	0.95	0.67	0.57	0.48
Restroom	0.98	0.69	0.59	0.49
Crime lab	1.28	0.90	0.77	0.64
Exercise	0.72	0.50	0.43	0.36
Sally Port	0.19	0.13	0.11	0.10
Locker Room & Shower	0.75	0.53	0.45	0.38
Break room	0.65	0.46	0.39	0.33
Private Office 24/7	1.11	0.78	0.67	0.56
Open office 24/7	0.98	0.69	0.59	0.49
Corridor 24/7	0.66	0.46	0.40	0.33
Conference 24/7	1.23	0.86	0.74	0.62
Storage 24/7	0.63	0.44	0.38	0.32
Building Average	**0.88**	**0.62**	**0.53**	**0.44**

Bundle Results

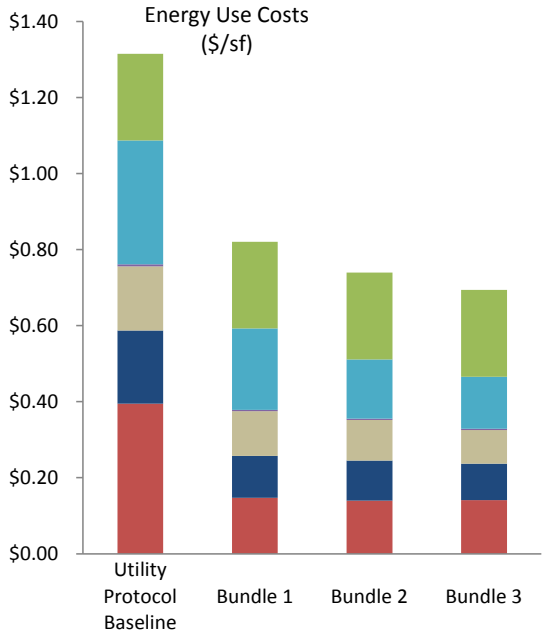
The simulation results for the bundles are shown below. The bundles are projected to save between $27,536 and $34,597 per year beyond the Baseline base energy use. The bundles show substantial savings in most categories.

More detailed results can be found in the Appendices.

Energy Use Intensity (EUI) and Annual Energy Costs for Bundles by End Use

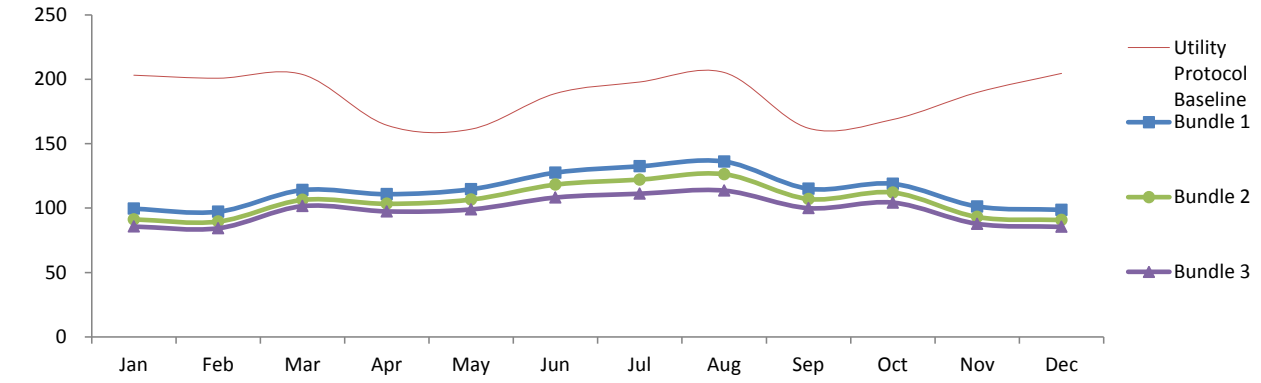


	Utility Protocol Baseline	Bundle 1	Bundle 2	Bundle 3
Equipment	11.3	11.3	11.3	11.3
Lighting	16.1	10.5	7.5	6.6
SWH	0.7	0.5	0.5	0.5
Fans & Pumps	8.4	5.7	5.1	4.2
Cooling	9.5	5.4	5.0	4.6
Heating	23.8	9.8	8.6	8.9
Total	69.8	43.0	38.0	36.1



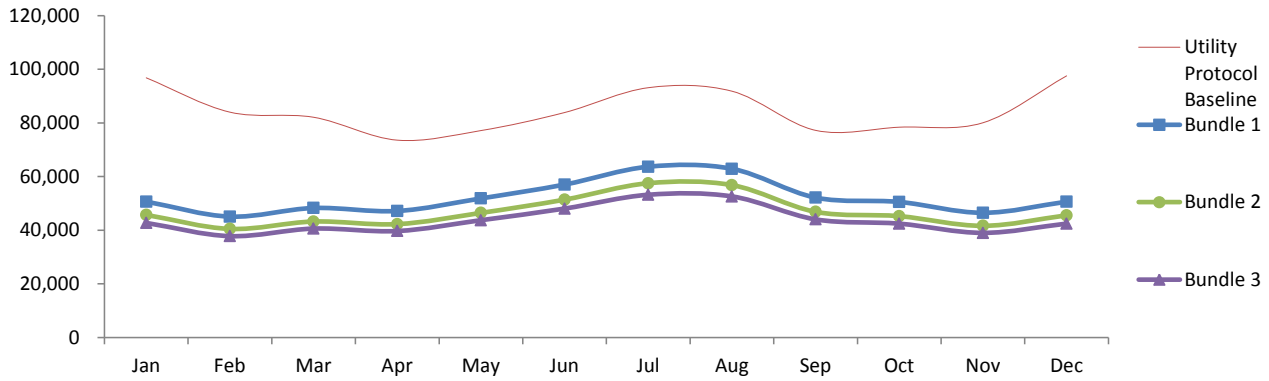
	Utility Protocol Baseline	Bundle 1	Bundle 2	Bundle 3
Equipment	$0.23	$0.23	$0.23	$0.23
Lighting	$0.33	$0.21	$0.16	$0.14
SWH	$0.01	$0.00	$0.00	$0.00
Fans & Pumps	$0.17	$0.12	$0.11	$0.09
Cooling	$0.19	$0.11	$0.11	$0.10
Heating	$0.39	$0.15	$0.14	$0.14
Total	$1.32	$0.82	$0.74	$0.69

Monthly Electricity Peak (kW)

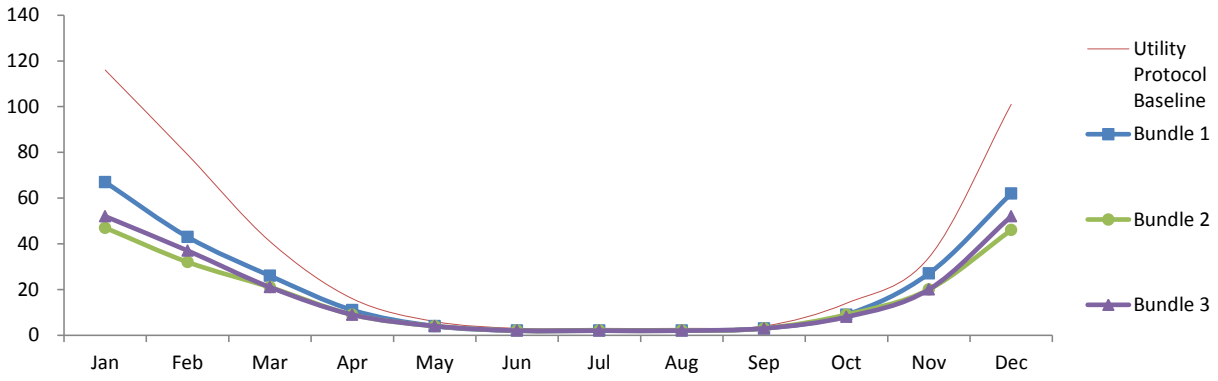


**The graph above shows the true building peak for each month, not the program definition of peak kW which may reference specific months and times of day.*

Monthly Electricity Use (kWh)



Monthly Gas Use (dekatherm)



Key Observations

- Bundles show kWh and peak kW savings throughout the year and gas savings during winter

Bundle Composition

In order to make informed design choices based on energy use, it is important to weigh the cost of design options against the potential for energy savings. One useful gauge of first cost versus annual savings is the simple payback period, which is the ratio of first cost to annual savings. Simple payback period represents the number of years required for the energy savings to pay for the improvements.

The Project Team assembled incremental construction costs for all strategies considered in the bundle analysis. The costs and paybacks for isolated strategies are listed below.

Strategy Selection		Savings vs Baseline					Bundles		
No.	Strategy Description	Percent KWH	Percent Gas	Energy $	Incremental Cost	Payback Years	1	2	3
1	**Envelope Insulation Strategies**								
EWC00	Baseline wall assembly	0.0%	0.0%	$0	$0	n/a			
EWC01	R-16 wall assembly	0.5%	15.0%	$915	$23,099	25.2	✓		
EWC02	R-20 wall assembly	0.8%	21.0%	$1,307	$41,956	32.1		✓	✓
ERC00	Baseline roof assembly	0.0%	0.0%	$0	$0	n/a			
ERC01	R-24 roof assembly	0.1%	6.0%	$371	$10,674	28.8	✓		
ERC02	R-30 roof assembly	0.3%	14.0%	$840	$30,688	36.5		✓	
ERC03	R-40 roof assembly	0.5%	20.0%	$1,283	$97,401	75.9			✓
1b	**Other Envelope Strategies**								
EWRF1	White roof	-0.2%	-1.0%	($149)	$33,357	n/a			
2	**Glazing Strategies**								
W3401	Baseline: Metal framing (all other)	0.0%	0.0%	$0	$0	n/a			
W0601	Low-E clear 1/ alum frame	1.7%	15.0%	$1,439	$6,753	4.7			
W0901	Low-E tint 1/ alum frame	0.8%	10.0%	$867	$15,914	18.4			
W1201	Low-E clear, high visible transmittance/ alum frame	0.7%	11.0%	$876	$21,039	24.0			
W1301	Low-E tint, high visible transmittance/ alum frame	0.2%	8.0%	$593	$25,576	43.1			
W6801	Design glazing	-0.2%	5.0%	$210	$20,327	96.8	✓	✓	✓
3	**Daylighting Control Strategies**								
D3401	No Daylighting	-0.5%	1.0%	($440)	$0	n/a			
D3402	Stepped daylighting controls	0.3%	-1.0%	$264	$3,501	13.3			
D3403	Dimming daylighting controls w/ LEDs	1.8%	-2.0%	$1,472	n/a	n/a	✓	✓	✓

Bundle Composition - continued

Strategy Selection		Savings vs Baseline					Bundles		
No.	Strategy Description	Percent KWH	Percent Gas	Energy $	Incremental Cost	Payback Years	1	2	3
4	**Lighting Control Strategies**								
LCPO8	Private office vacancy sensor control	0.1%	0.0%	$60	$1,149	19.1		✓	✓
LCOO8	Open office vacancy sensor control	1.1%	-4.0%	$503	$2,206	4.4		✓	✓
LCCN8	Conference vacancy sensor control	0.0%	0.0%	$40	$411	10.3		✓	✓
LCCM8	Briefing/Multi-Purp/Tactical vacancy sensor control	0.1%	0.0%	$103	$590	5.7		✓	✓
LCCG8	Community room vacancy sensor control	0.0%	0.0%	$12	$425	35.4		✓	✓
LCDC8	IT Equipment vacancy sensor control	0.2%	0.0%	$118	$106	0.9		✓	✓
LCCI1	Corridor occupancy sensor control	0.1%	0.0%	$47	$719	15.3	✓	✓	✓
LCCI8	Corridor vacancy sensor control	0.1%	0.0%	$68	$719	10.6			
LCLO1	Lobby occupancy sensor control	1.4%	4.0%	$1,041	$537	0.5	✓		
LCLO8	Lobby vacancy sensor control	1.6%	8.0%	$1,393	$537	0.4		✓	✓
LCST8	Storage vacancy sensor control	0.1%	0.0%	$55	$2,423	44.1		✓	✓
LCME8	Mech/elec vacancy sensor control	0.4%	-2.0%	$240	$623	2.6		✓	✓
LCRR8	Restroom vacancy sensor control	0.0%	0.0%	$14	$274	19.6		✓	✓
LCLB2	Crime lab occupancy sensor control to 1/3 level	0.3%	0.0%	$235	$298	1.3	✓		
LCLB8	Crime lab vacancy sensor control	0.4%	0.0%	$299	$298	1.0		✓	✓
LCFT8	Exercise vacancy sensor control	0.1%	0.0%	$71	$350	4.9		✓	✓
LCLR8	Locker Room & Shower vacancy sensor control	0.1%	0.0%	$37	$1,087	29.4		✓	✓
LCDN5	Break room manual dimming	0.0%	3.0%	$186	$0	imm			✓
LCDN8	Break room vacancy sensor control	0.1%	3.0%	$194	$173	0.9		✓	✓
LCOF8	Private Office 24/7 vacancy sensor control	0.0%	0.0%	$49	$418	8.5		✓	✓
LCOP8	Open office 24/7 vacancy sensor control	1.8%	-2.0%	$1,044	$1,194	1.1		✓	✓
LCCR1	Corridor 24/7 occupancy sensor control	0.0%	0.0%	$9	$271	30.1	✓	✓	✓
LCCR8	Corridor 24/7 vacancy sensor control	0.1%	0.0%	$37	$271	7.3			
LCCF8	Conference 24/7 vacancy sensor control	0.0%	0.0%	$9	$87	9.7		✓	✓
LCSR8	Storage 24/7 vacancy sensor control	0.0%	0.0%	$1	$176	176.0		✓	✓
5	**Lighting Design Strategies**								
L0CBW	Baseline Building Wide lighting @ 0.88 Wsf	0.0%	0.0%	$0	$0	n/a			
L01BW	Building wide 30% lower than 90.1-2010	7.1%	4.0%	$5,568	n/a	n/a	✓		
L02BW	Building wide 40% lower than 90.1-2010	9.4%	6.0%	$7,344	n/a	n/a		✓	
L03BW	Building wide 50% lower than 90.1-2010	11.7%	6.0%	$9,028	n/a	n/a			✓
7	**HVAC Efficiency Strategies**								
MAC01	Air-cooled chiller, 5% decreased KW/ton	1.2%	0.0%	$1,042	$0	imm			✓
MAC02	Air-cooled chiller, 13% decreased KW/ton	1.2%	0.0%	$1,229	$9,078	7.4			
MAC03	Air-cooled chiller, 20% decreased KW/ton	1.3%	0.0%	$1,443	$24,392	16.9			
MHT01	Gas boiler at 85% efficiency	0.0%	4.0%	$165	$2,395	14.5			
MHT02	Condensing gas boiler at 95% efficiency	0.1%	10.0%	$515	$8,688	16.9	✓	✓	✓
MWW01	Water-to-water heat pump	29.5%	4.0%	$20,986	$250,000	11.9	✓	✓	✓

Bundle Composition - continued

Strategy Selection		Savings vs Baseline					Bundles		
No.	Strategy Description	Percent KWH	Percent Gas	Energy $	Incremental Cost	Payback Years	1	2	3
8a	**Fan Strategies**								
MMT03	Exceeds Premium efficiency supply/return fan motors	0.1%	0.0%	$42	$2,785	66.3			✓
MFD00	Baseline fan system power limitation	0.0%	0.0%	$0	$0	n/a			
MFD01	Fan system power at 1.11 bhp/1000 cfm	0.8%	0.0%	$602	$2,228	3.7	✓		
MFD02	Fan system power at 0.99 bhp/1000 cfm	1.7%	-1.0%	$1,180	$4,455	3.8		✓	
MFD03	Fan system power at 0.87 bhp/1000 cfm	2.5%	-1.0%	$1,762	$6,683	3.8			✓
8b	**Pump Strategies**								
MMT04	Exceeds Premium efficiency pump motors	0.0%	0.0%	$12	$6,683	556.9			✓
MPC00	Baseline chilled water pump system power limitation	0.0%	0.0%	$0	$0	n/a			
MPC01	Chilled water pump system power at 19.8 W/gpm	0.2%	0.0%	$193	$9,467	49.1			✓
MPC02	Chilled water pump system power at 17.6 W/gpm	0.4%	0.0%	$382	$18,935	49.6			
MPC03	Chilled water pump system power at 15.4 W/gpm	0.7%	0.0%	$573	$28,402	49.6			
MPC04	Chilled water pump system power at 21.9 W/gpm	1.1%	0.0%	$929	n/a	n/a			
MPH00	Baseline hot water pump system power limitation	0.0%	0.0%	$0	$0	n/a			
MPH01	Hot water pump system power at 17.1 W/gpm	0.0%	0.0%	$2	$9,467	4,733.5			✓
MPH02	Hot water pump system power at 15.2 W/gpm	0.0%	0.0%	$29	$18,935	652.9			
MPH03	Hot water pump system power at 13.3 W/gpm	0.0%	0.0%	$31	$28,402	916.2			
MPP01	VFD on heating pump	0.0%	0.0%	$27	$668	24.7	✓	✓	✓
MPP02	VFD on cooling pump	1.7%	0.0%	$1,411	$668	0.5	✓	✓	✓
MPP03	Boiler pump head pressure reset control	0.0%	0.0%	$27	$0	imm			
9	**Conditioning of Outside Air Strategies**								
MOA02	CO2 control of outside air	1.4%	13.0%	$2,001	$21,998	11.0			✓
MOA22	Carbon monoxide sensor control of garage vent fans	0.4%	4.0%	$356	$0	imm	✓	✓	✓
MHRT1	Total heat recovery	1.1%	11.0%	$1,871	$46,669	24.9	✓	✓	✓
12	**Service Water Heating Strategies**								
MHW01	85% service water heating efficiency	0.0%	0.0%	$18	$724	40.2			
MHW02	90% service water heating efficiency	0.0%	1.0%	$33	$1,448	43.9			
MHW03	95% service water heating efficiency	0.0%	2.0%	$104	$2,172	20.9	✓	✓	✓

Payback with Energy Construction Incentive

The Commercial New Construction Program program promotes the implementation of cost-effective bundles of strategies by proposing cash incentives to reduce the added cost of implementing the selected energy conserving strategies. The bundles discussed on the previous pages were selected by the designers to cover a range of scenarios so that one of these bundles would be a likely candidate for implementation in the final building.

Based on the bundled model results, the possible incentives have been calculated as shown in the following tables.

Bundle Description	Peak kW Savings	% Peak kW Savings	kWh Savings	% kWh Savings	Therm Savings	% Therm Savings
Bundle 1	70	34%	389,365	38%	1,623	39%
Bundle 2	80	39%	452,655	45%	2,238	53%
Bundle 3	92	45%	489,435	48%	2,082	50%

Bundle Description	Energy Cost Savings	Incremental First Cost	MidAmerican Energy Electric Incentive	Black Hills Energy Gas Incentive	Total Incentive	Payback in Years (after incentive)
Bundle 1	$27,536	$367,018	$62,298	$2,662	$64,960	11.0
Bundle 2	$32,053	$419,808	$79,215	$4,096	$83,311	10.5
Bundle 3	$34,597	$539,149	$87,119	$3,748	$90,867	13.0

The incentive offers listed above make the presumption that the selected bundle will be implemented in its entirety. Any changes from the specifications of the Selected Bundle should be reported to MidAmerican Energy. If it is deemed that these changes would have a significant impact on energy, then MidAmerican Energy will make adjustments to the incentives accordingly. The incentive will reduce the paybacks for each of the bundles, as shown in the tables above.

** Black Hills Energy's energy efficiency natural gas incentives are available to customers that purchase natural gas service (commodity) from Black Hills Energy. Customers who pay into the energy efficiency cost recovery fund are eligible for natural gas incentives; customers who do not pay into the fund are not eligible for natural gas energy efficiency incentives. It is imperative that Black Hills Energy and*

The Weidt Group are notified of natural gas purchasing intentions as early in the process as possible to ensure that accurate incentives are calculated.

*** Commercial New Construction incentives cannot reduce the simple payback below one year; MidAmerican Energy Company's Commercial New Construction incentives may not exceed 70% of the total bundled incremental strategy costs, and are capped at $1 million per building.*

***Note**: Subject to the following qualifications, the computer model offers sophisticated predictions of energy savings with estimations as good as any other means available for a building that has not been built.*

The strategy and bundle results compare relative differences in net energy use for design alternatives. The results are not appropriate for system design and/or equipment selection; these are responsibilities of the registered design professionals of record.

The actual energy use of this building will be different from simulated results. Building systems and other operating parameters provided by the Design Team and modeled by The Weidt Group approximate actual conditions, but differences in weather, operating parameters, occupancy level, and changes that occur through the bidding and construction process will result in annual energy costs that will be different from what is predicted here. However, when a bundle of strategies is selected relative to other alternatives, its energy (and dollar) conserving value can be expected to remain constant relative to the other alternatives, and the magnitude of the cost should be approximately as predicted.

Thus, implementation of a bundle of strategies offers the opportunity for energy savings, but the realization of those savings is the responsibility of the owner/operator of the building- not MidAmerican Energy, Black Hills Energy or The Weidt Group.

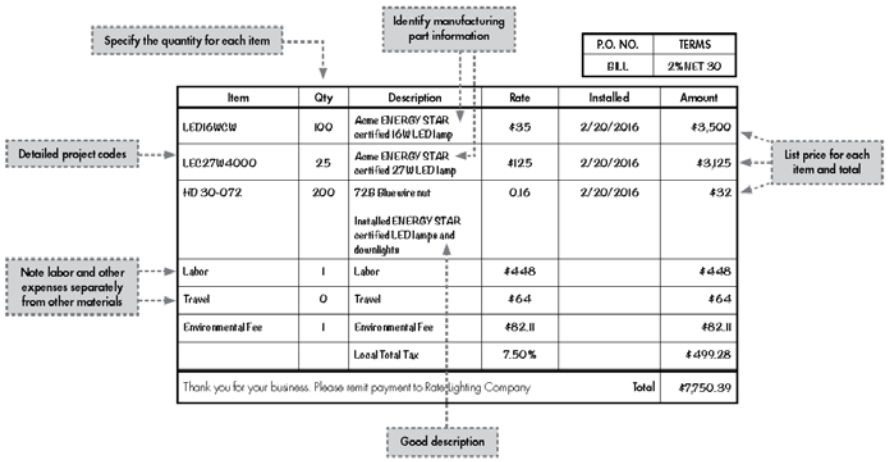
Prescriptive LED Lighting Rebate Option

Program participants implementing qualified interior and exterior LED lighting equipment are eligible to receive an alternative rebate based on the prescriptive rebate schedule rate in affect at the time of purchase. Once a lighting fixture type(s) and count is determined, The Weidt Group will assist the team in evaluating each space asset area to determine if the Prescriptive LED Lighting Rebate Option provides a higher incentive than the lighting incentive calculated by the energy model. The owner may receive the higher of the two incentive offerings on a space asset area basis provided eligibility requirements are met. All other implemented strategies will receive the incentive calculated by the energy model.

Eligibility Requirements

- Provide prior to on-site verification, lighting fixture invoice(s) including date of purchase, itemized quantity, price, manufacturer's make and model numbers and product codes for each material item (See example below)
- Provide prior to on-site verification, original equipment manufacturer (OEM) specification sheets
- LED lighting rebate cannot exceed 70 percent of the installed cost (materials and qualified contractor labor).
- Lighting fixtures must be DesignLights Consortium qualified to be eligible for the prescriptive lighting rebate option.
- A minimum of 1,000 annual operating hours required.

Itemized Invoice Example



P.O. NO.	TERMS
BILL	2%NET 30

Item	Qty	Description	Rate	Installed	Amount
LED16WCW	100	Acme ENERGY STAR certified 16W LED lamp	$35	2/20/2016	$3,500
LE027W4000	25	Acme ENERGY STAR certified 27W LED lamp	$125	2/20/2016	$3,125
HD 30-072	200	72B Blue wire nut Installed ENERGY STAR certified LED lamps and downlights	0.16	2/20/2016	$32
Labor	1	Labor	$448		$448
Travel	0	Travel	$64		$64
Environmental Fee	1	Environmental Fee	$82.11		$82.11
		Local Total Tax	7.50%		$499.28
Thank you for your business. Please remit payment to RateLighting Company				Total	$7,750.39

Verification

This Report concludes the Energy Design Assistance process. The next stage will be Verification, a process that seeks to assure that one of the bundles is implemented.

The Weidt Group serves as a resource to verify that the accepted measures are installed. The process will be laid out in detail in the coming weeks, but it will generally include the following.

- Owner notifies The Weidt Group of the Bundle selection
- The Weidt Group sends a Bundle Requirements Document to the Project Team, tailored to the Selected Bundle strategies
- Once Construction Documents are complete, the Project Team will provide Construction Documents and Specifications (electronic format preferred) to The Weidt Group
- The Weidt Group issues a Construction Documents Review to the entire team
- MidAmerican Energy and Black Hills Energy notify the Owner of the estimated construction incentives based upon the Construction Documents Review

Building Under Construction

- Field verification of installed strategies by The Weidt Group, when the building is completed and occupied
- The Weidt Group completes a Field Verification Report, as to status of strategy implementation, and circulates to the entire team
- Based upon Verification Report, MidAmerican Energy and Black Hills Energy provide the incentive payments to the Owner

The Verification process is designed to assist the Owner and Project Team in knowing whether or not the strategies are installed as expected. If strategies are not found as expected, notification is given, so that corrections can be made. If some of the chosen strategies are not implemented within the Selected Bundle, MidAmerican Energy or Black Hills Energy may choose to adjust the incentive amount.

Strategy Descriptions and Results

Envelope Insulation Strategies

Strategy Objectives

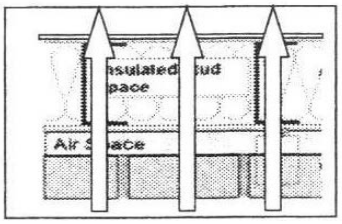
Minimize heat loss through cost-effective insulation choices.

Strategy Descriptions

The envelope insulation strategies incorporate additional insulation to the roof and walls of the building. The insulation R factors listed in the table below are overall average thermal resistance values of the entire wall or roof assembly, accounting for:

- Effects of thermal bridging of structural elements (studs, joists, columns, etc.)
- Average thickness of tapered roofs
- Average for multiple wall or roof assemblies
- Exterior and interior finishes and air films

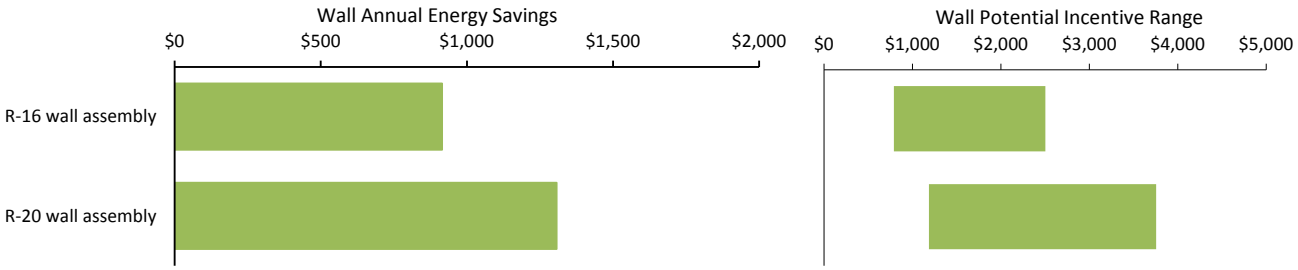
The following table identifies a few wall construction types to illustrate the effect of thermal bridging.

Thermal Bridging in a Stud Wall	Typical Construction	Assembly
 R-3 R-22 R-3	6” metal studs with R-19 batt insulation	R-10 (U-0.10)
	6” wood studs with R-19 batt insulation	R-16 (U-0.06)
	6” metal studs with R-19 batt insulation and R-6 (1” polyiso) continuous insulation	R-16 (U-0.06)
	8” CMU with R-12 (2” polyisocyanurate) continuous insulation	R-16 (U-0.06)

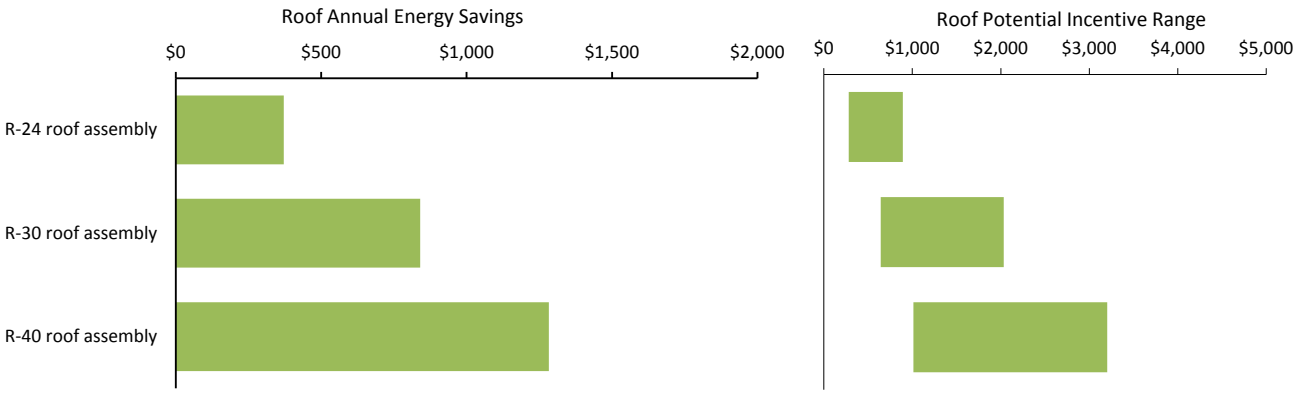
Strategy ID	Envelope Insulation Strategies	Baseline	Strategy Level	Notes
EWC00	Baseline wall assembly	R-11.1	R-11.1	
EWC01	R-16 wall assembly	R-11.1	R-16	
EWC02	R-20 wall assembly	R-11.1	R-20	
ERC00	Baseline roof assembly	R-20.8	R-20.8	
ERC01	R-24 roof assembly	R-20.8	R-24	
ERC02	R-30 roof assembly	R-20.8	R-30	
ERC03	R-40 roof assembly	R-20.8	R-40	

Envelope Insulation Results

Wall Insulation Variations



Roof Insulation Variations



Key Points

- Increased insulation values for roof and walls save energy
- In general, increasing roof and wall insulation values will not be as cost-effective as the other strategies that have been investigated

Other Envelope Strategies

Strategy Objectives

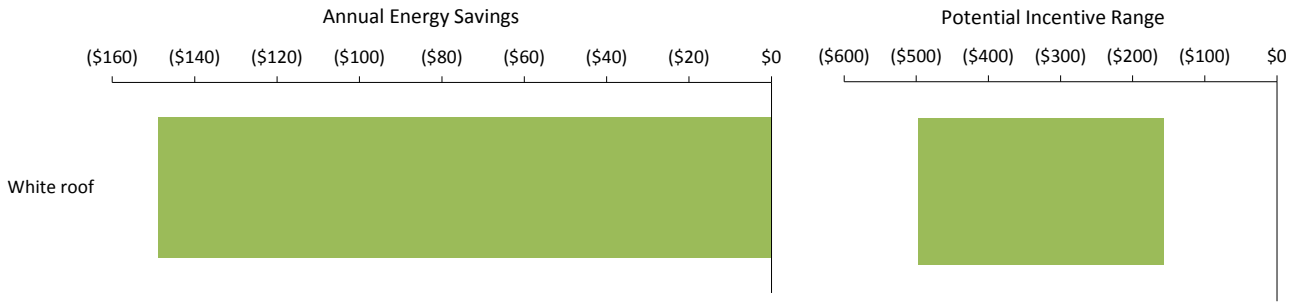
Reduce undesired heat loss or gain through cost-effective envelope upgrades beyond increased thermal resistance.

Strategy Descriptions

White roof - Reduce heat gain through the use of a high reflective roof membrane, minimum SRI of 82.

Strategy ID	Other Envelope Strategies	Baseline	Strategy Level	Notes
EWRF1	White roof	Std roof	White roof	

Other Envelope Results



Key Points

- Although white roof shows small energy penalty, it may have other environmental benefits

Glazing Strategies

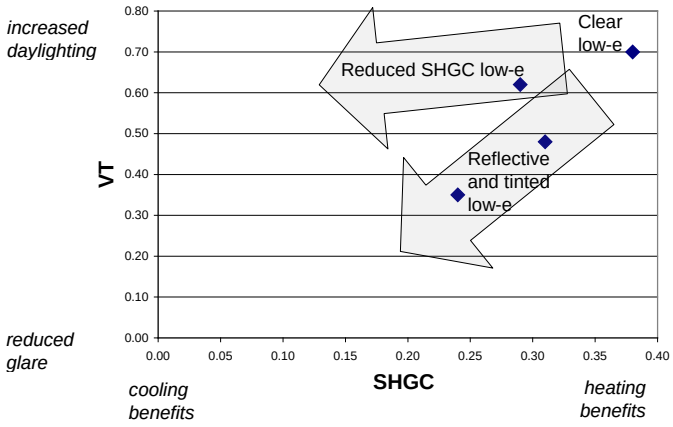
Strategy Objectives

Manage heat gain, and daylighting through appropriate glass selection.

Strategy Descriptions

A variety of glass types are evaluated compared to the Baseline level glass assembly.

The strategies listed below bracket a range of glazing characteristics which are available from a number of manufacturers, along with a much larger range of variations based on extent and color of coatings and tints, number of panes and suspended films, etc. Other characteristics specific to one manufacturer or product can be simulated.

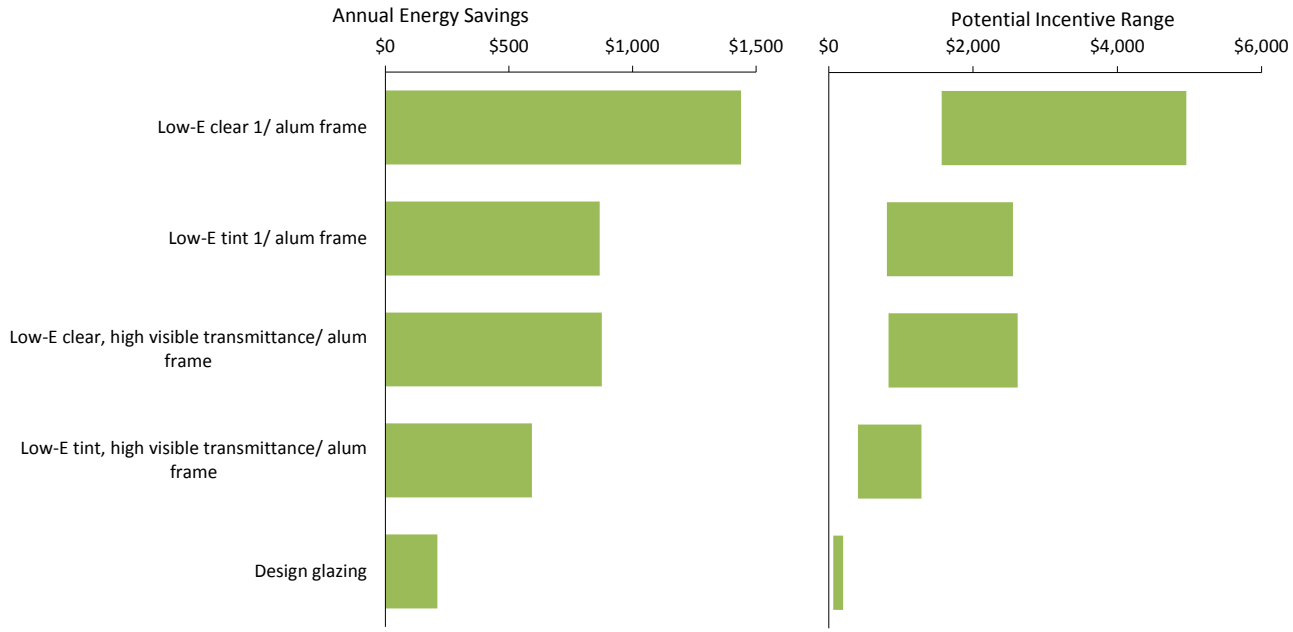


Solar heat gain coefficient (SHGC) is the fraction of total incident solar radiation that is transferred through the glazing system.

Visible light transmittance is a ratio of the amount of light radiation transmitted through the glass compared to the amount of light striking the exterior surface. Higher values provide more daylight.

Strategy ID	Glazing Strategies	Unit U-Factor	COG U-Factor	SHGC	Visible Trans.
W3401	Baseline: Metal framing (all other)	0.55	N/A	0.40	0.41
W0601	Low-E clear 1/ alum frame	0.44	0.31	0.61	0.74
W0901	Low-E tint 1/ alum frame	0.44	0.31	0.41	0.63
W1201	Low-E clear, high visible transmittance/ alum frame	0.42	0.29	0.38	0.69
W1301	Low-E tint, high visible transmittance/ alum frame	0.42	0.29	0.30	0.60
W6801	Design glazing	0.45	0.31	0.29	0.41

Glazing Results



Key Points

- The results account for both thermal and solar losses and gains, but do not account for electrical lighting savings due to daylighting.

This page intentionally left blank

Daylighting Control Strategies

Strategy Objectives

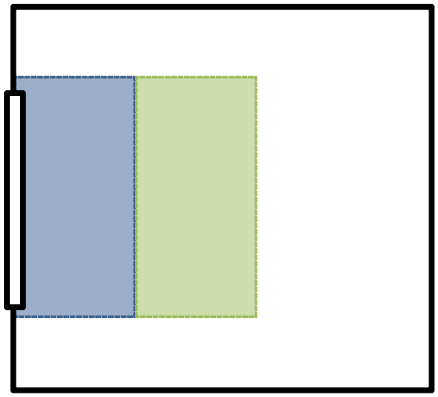
Reduce electric lighting in spaces with daylight, utilizing automated or manual controls.

Strategy Descriptions

This section describes daylighting controls beyond base requirements for interior spaces nearest the windows.

Elevation View

Plan View



Baseline Daylight Zone

Strategy Daylight Zone

The diagrams to the left provide depiction of the baseline daylight zone and the strategy daylight zone for a sidelight example.

The *baseline daylight zone* is a space where daylighting controls are required in the baseline. This baseline daylight zone size is determined by the placement of the glazing, the size of the adjoining room and the location of any obstructions between the daylight and work surfaces.

The base lighting control sequence within the baseline daylight zone is a two-step control sequence. One step may be all lamps 'off' in this zone.

The *strategy daylight zone* builds upon the baseline daylighting zone to identify additional possible savings through optimizing glazing, furniture placement and lighting control equipment.

The baseline establishes a similar baseline daylight zone and controls for spaces with toplighting.

The following paragraphs describe incremental daylighting control strategies for lighting near either sidelit or toplit spaces.

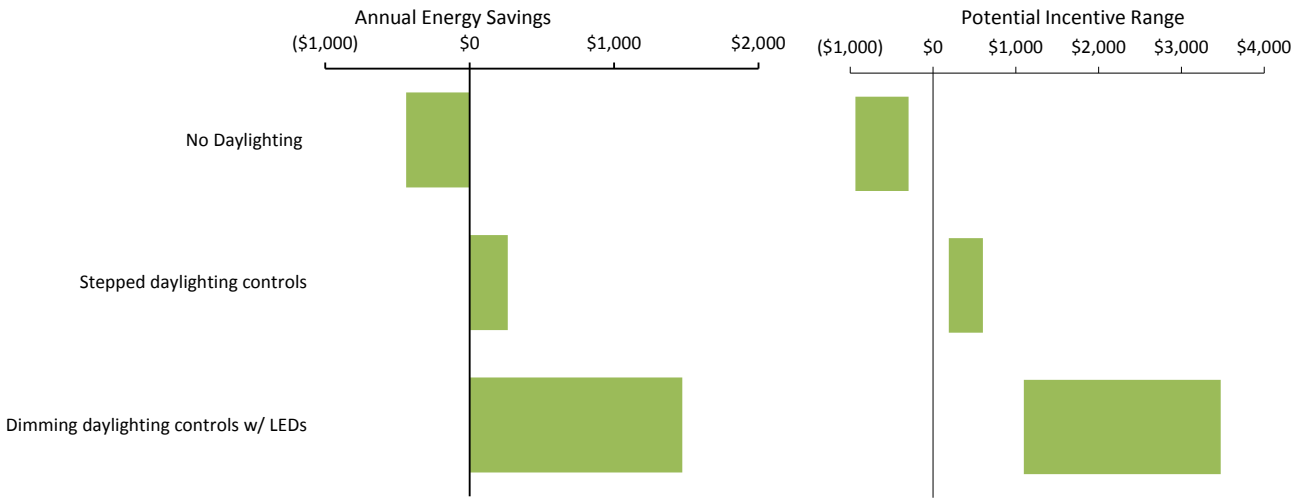
Dimming Daylighting Control Systems use interior photo-sensors to control electronic dimming ballasts that gradually dim or brighten lamps within the baseline and strategy daylight zones. This system can be transparent to the building occupant

since the dimming system continuously maintains the designed light levels without switching lamps on or off.

Stepped Daylighting Control Systems turn off selected lamps/fixtures within the strategy daylight zone. This works best where the daylight level is above the design light level most of the day. Control device options include *exterior* or *interior photo-sensors* measuring the daylight source connected to a lighting relay able to switch lights on or off based on daylight availability or an *astronomical time clock*, programmed to automatically switch lights off after sunrise and on before sunset, varying daily.

Strategy ID	Daylighting Control Strategies	Region of building	Daylight Control	Notes
D3401	No Daylighting		No Daylighting	
D3402	Stepped daylighting controls		Fluorescent Stepped	5,739 sf of area controlled
D3403	Dimming daylighting controls w/ LEDs		LED Dimming	12,210 sf of area controlled

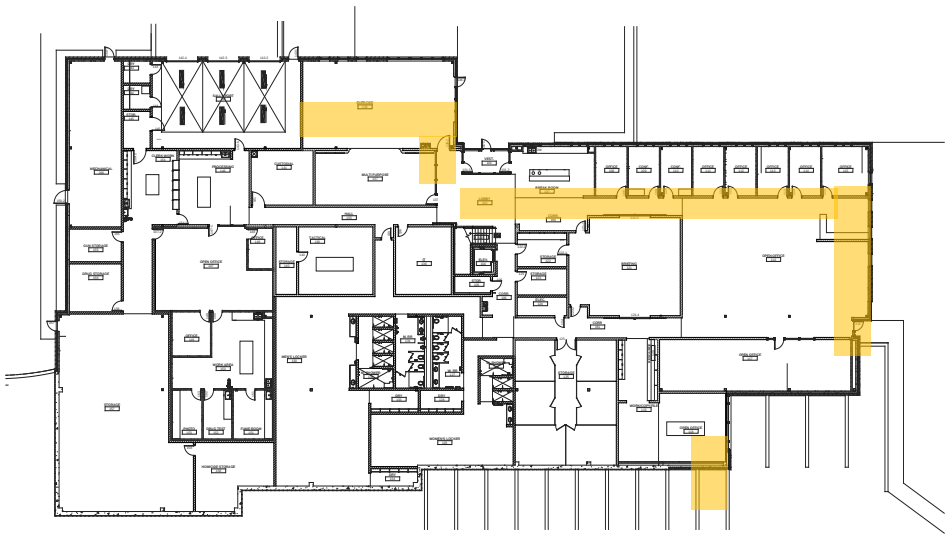
Daylighting Control Results



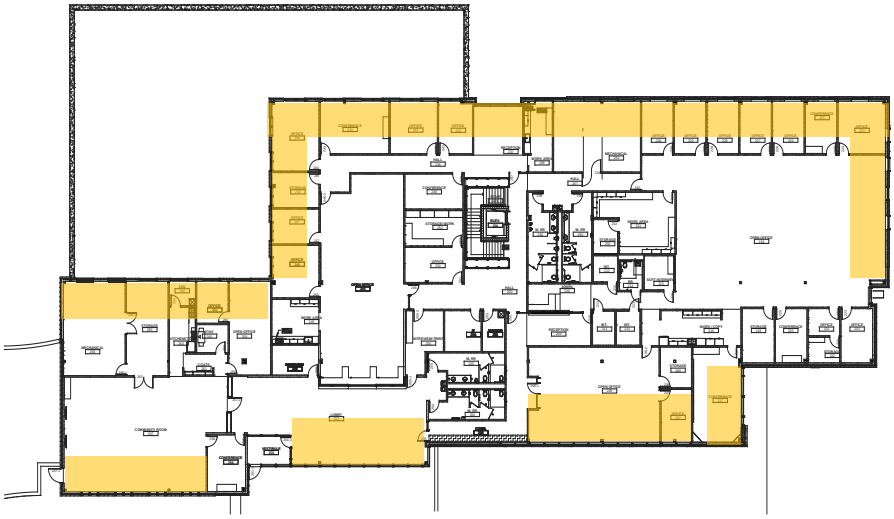
Key Points

- Daylight control strategies provide significant energy savings

Daylighting Control Zones



Lower level



Upper level

This page intentionally left blank

Lighting Control Strategies

Strategy Objectives

Reduce electric lighting energy by turning lights off (or down) when they are not needed.

Baseline lighting control requirements

Manual wall switch is required when the space enclosed by ceiling-height partitions.

Dual level switching (0%-50%-100%) is a baseline requirement for many spaces enclosed by ceiling-height partitions. Please see the table below.

Occupancy sensor control is required for several commercial space types. The applicable space types are noted in the table below.

Parking garage timers, occupancy sensors and daylight control sensors are required in applicable areas according to ASHRAE 90.1-2010 9.4.1.3.

Stairwells require 50% of the installed lighting power controlled by occupancy sensors.

Space Type → Baseline Control Type ↓	Apartment	Assembly	Auditorium	Cafeteria	Circulation	Conference, training rooms	Classroom, lecture halls	Dorm	Exam room	Fitness room	Garage	Gym	Hospitality Guest Bathrooms[1]	Lobby	Laboratory
Dual Level Switching															
Occupancy Sensors															

Space Type → Baseline Control Type ↓	Lobby	Locker room	Lunch room/break room	Mechanical/electrical	Media center	Open office	Patient room	Private office	Public Assembly	Restroom	Stairway[2]	Storage	Vehicle Service	Warehouse
Dual Level Switching														
Occupancy Sensors														

[1] Except night lighting

[2] 50% of lighting

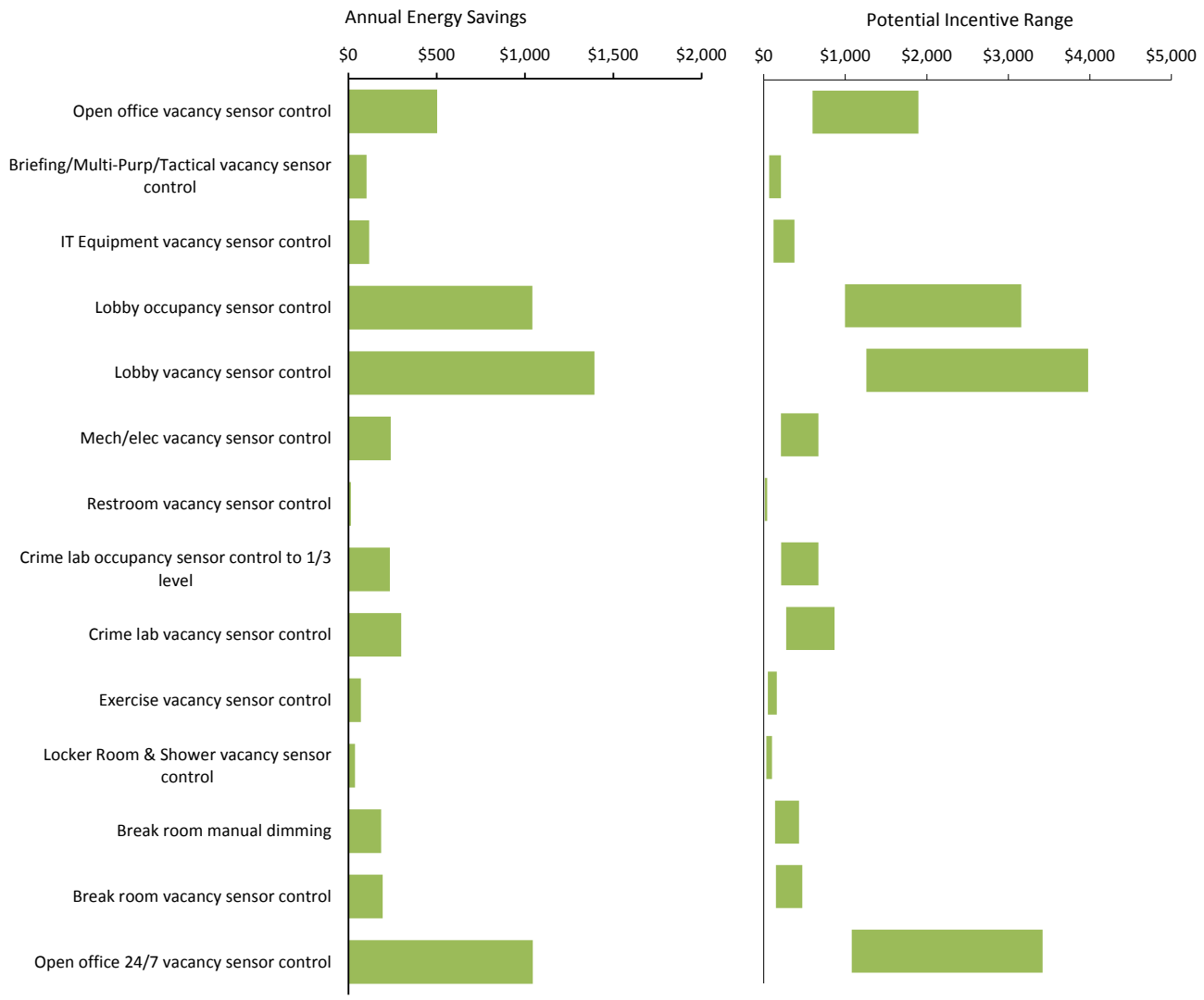
Strategy Descriptions

Vacancy sensor control is similar to an occupancy sensor control except that the lighting system stays in the 'off' state until the occupant physically engages a switch device.

Manual dimming is applicable for rooms with concentrated Audio/Visual requirements. Electronic dimming ballasts are used with manual dimming controls in place of wall switches.

Strategy ID	Lighting Control Strategies	Peak reduction	Annual hrs reduction	Notes
LCPO8	Private office vacancy sensor control	15%	30%	
LCOO8	Open office vacancy sensor control	11%	51%	
LCCN8	Conference vacancy sensor control	15%	28%	
LCCM8	Briefing/Multi-Purp/Tactical vacancy sensor control	5%	5%	
LCCG8	Community room vacancy sensor control	15%	28%	
LCDC8	IT Equipment vacancy sensor control	36%	51%	
LCCI1	Corridor occupancy sensor control	5%	30%	
LCCI8	Corridor vacancy sensor control	16%	41%	
LCLO1	Lobby occupancy sensor control	5%	30%	
LCLO8	Lobby vacancy sensor control	16%	41%	
LCST8	Storage vacancy sensor control	15%	31%	
LCME8	Mech/elec vacancy sensor control	61%	81%	
LCRR8	Restroom vacancy sensor control	15%	26%	
LCLB2	Crime lab occupancy sensor control to 1/3 level	20%	35%	
LCLB8	Crime lab vacancy sensor control	31%	46%	
LCFT8	Exercise vacancy sensor control	36%	51%	
LCLR8	Locker Room & Shower vacancy sensor control	5%	5%	
LCDN5	Break room manual dimming	20%	20%	
LCDN8	Break room vacancy sensor control	16%	36%	
LCOF8	Private Office 24/7 vacancy sensor control	5%	5%	
LCOP8	Open office 24/7 vacancy sensor control	11%	51%	
LCCR1	Corridor 24/7 occupancy sensor control	5%	30%	
LCCR8	Corridor 24/7 vacancy sensor control	16%	41%	
LCCF8	Conference 24/7 vacancy sensor control	5%	5%	
LCSR8	Storage 24/7 vacancy sensor control	5%	5%	

Lighting Control Results



Key Points

- Savings due to occupancy sensors can be significant for a building with diverse functions and rooms with intermittent use
- Depending on the base lighting level and occupancy assumptions, some space types save more than others
- If your occupancy patterns are different from those assumed for this model, savings could vary from results presented

Lighting Design Strategies

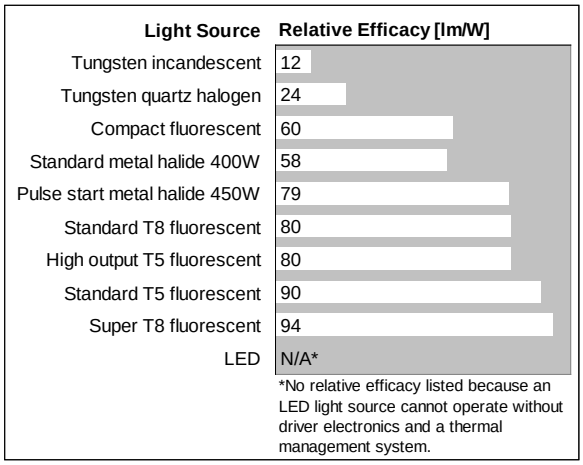
Strategy Objectives

Reduce electric lighting energy through appropriate lighting equipment selection and layout.

Strategy Descriptions

The design strategies listed below may combine various light sources, luminaire types, layouts, and surface reflectances (wall, ceiling, etc) to achieve a desired light level in footcandles (fc).

Light Source Type has the largest impact on reducing the overall lighting power density. Light sources with high efficacies (high lumens per Watt) will require less power for the same light output, all other factors being equal. The graph below shows the average efficacies of various light sources. These values are known as *relative efficacies* because they are for the light source only, before taking into account losses from the fixture, optics and other components.



Luminaire Type also influences lighting power density because some luminaires are more effective at providing general ambient lighting, while others are intended to provide directional and/or supplemental lighting. *Absolute efficacy* accounts for the combined efficiency of both the light source and the luminaire. The table below shows typical ranges for absolute efficacies of various types of complete luminaires (lamp plus fixture and other components).

Luminaire Type	Light Source	Absolute (Luminaire) Efficacy [lm/W]
Recessed Downlight	Compact Fluorescent	27 – 53
	LED	33 – 75
Track/Spotlight	LED	25 – 48
2X2 Troffer	17W T8 Linear Fluorescent	49
	32W T8 U-bent Fluorescent	44 – 56
	28W T5 Single Tube CFL	60 – 64
	LED	36 – 80
High Bay	Metal Halide	53
	Standard T8 Fluorescent	79
	LED	51 – 80
Under Cabinet	Compact Fluorescent	20 – 36
	LED	16 – 54
Task/Portable	Halogen	9 – 11
	Compact Fluorescent	24 – 43
	LED	16 – 42

Source: DOE Commercially Available LED Product Evaluation and Reporting (CALiPER) program, Detailed Test Reports, Jul 2006 – Oct 2011.

Total Lumen Output of the luminaire is also important to consider. Although a particular luminaire may have a high efficacy (lumen output per Watt), the total lumen output may be lower than a comparable luminaire. This is particularly true of LED luminaires. More luminaires arranged in a tighter spacing would then be required in order to achieve the desired light level.

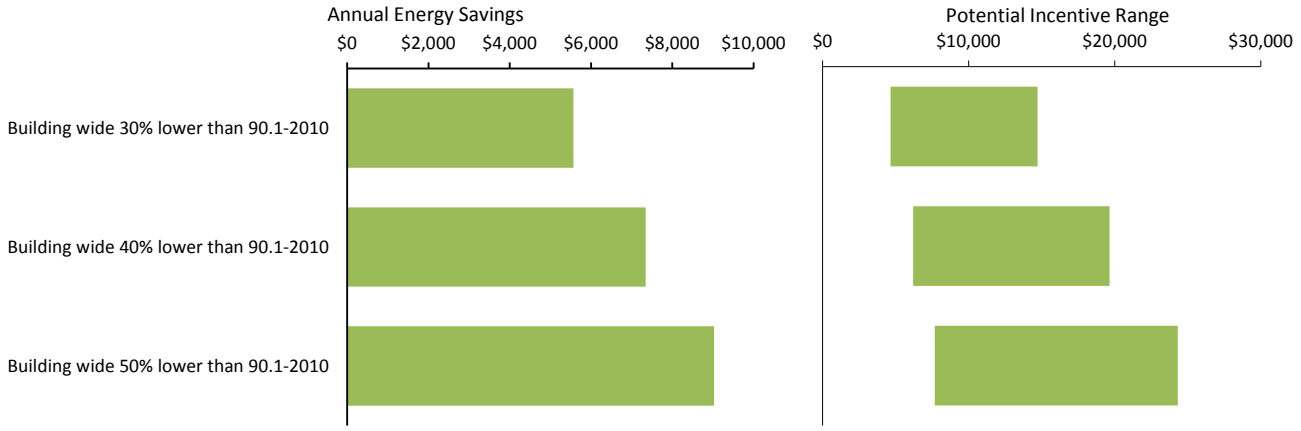
Strategy ID	Lighting Design Strategies	Typical Size	Baseline	Strategy max W/sf	Notes
L01BW	Building wide 30% lower than 90.1-2010		0.88	0.62	Fluorescent
L02BW	Building wide 40% lower than 90.1-2010		0.88	0.53	Fluorescent
L03BW	Building wide 50% lower than 90.1-2010		0.88	0.44	LED

Important: These are example design strategies that bracket a range of installed watts per sq. ft., based on generic lighting design alternatives. Watts/sq. ft. is the

critical metric defining each strategy – not footcandle or system type. Also, ASHRAE 90.1-2010 provides for additional baseline lighting power allowances for tall or odd-shaped spaces. This provision may add up to 20% to the baseline allowance depending on the room geometry.

Space Type	Baseline	Building wide 30% lower than 90.1-2010	Building wide 40% lower than 90.1-2010	Building wide 50% lower than 90.1-2010
Private office	1.11	0.78	0.67	0.56
Open office	0.98	0.69	0.59	0.49
Conference	1.23	0.86	0.74	0.62
Briefing/Multi-Purp/Tactical	1.23	0.86	0.74	0.62
Community room	1.23	0.86	0.74	0.62
IT Equipment	0.98	0.69	0.59	0.49
Corridor	0.66	0.46	0.40	0.33
Lobby	0.90	0.63	0.54	0.45
Storage	0.63	0.44	0.38	0.32
Mech/elec	0.95	0.67	0.57	0.48
Restroom	0.98	0.69	0.59	0.49
Crime lab	1.28	0.90	0.77	0.64
Exercise	0.72	0.50	0.43	0.36
Sally Port	0.19	0.13	0.11	0.10
Locker Room & Shower	0.75	0.53	0.45	0.38
Break room	0.65	0.46	0.39	0.33
Private Office 24/7	1.11	0.78	0.67	0.56
Open office 24/7	0.98	0.69	0.59	0.49
Corridor 24/7	0.66	0.46	0.40	0.33
Conference 24/7	1.23	0.86	0.74	0.62
Storage 24/7	0.63	0.44	0.38	0.32
Building Average	**0.88**	**0.62**	**0.53**	**0.44**

Lighting Design Results



Key Points

- Successful implementation of these strategies requires the power density ranges in the table on the previous page be met for each lighting design strategy selected

Base HVAC Efficiency Strategies

Strategy Objectives

Reduce energy use by selecting higher efficiency systems

Heating & Cooling Strategy Descriptions

Water-to-water heat pump as central heating/cooling plant, with ground source condensing circuits supplemented by boiler/chiller: A water-to-water heat pump serves as the central heating and cooling plant for the building. This machine adds or removes heat from the airstream as needed by the building, using hydronic heat exchangers. The design also incorporates a closed loop ground source circuit as both the primary heat source and heat rejection body for the water-to-water heat pump. In addition, the ground heat source is boosted by a natural gas fired boiler sized to (50%) of the building load. In this sequence the ground circuit provides the first stage of loop heat source and the gas fired boiler follows as needed to meet loop temperature requirements. In addition, the ground rejection is boosted by an air-cooled chiller sized to (50%) of the building load. In this sequence the ground circuit provides the first stage of heat rejection and air-cooled chiller follows as needed to meet loop temperature requirements.

Strategy ID	Heat Pump Efficiency Strategies	Baseline	Strategy EER/COP	Reference Size Tons
MPR01	Water-to-water heat pump (sizing run)	sizing runs	sizing runs	
MWW01	Water-to-water heat pump		16.6 EER/3.7 COP	

Cooling Efficiency Strategy Descriptions

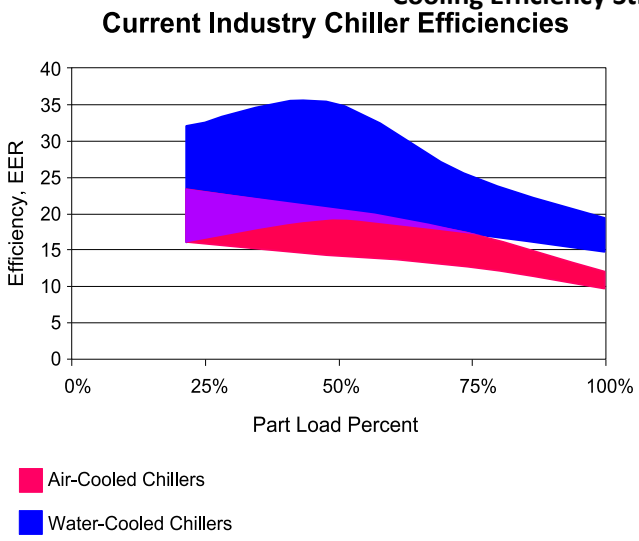


Diagram notes: The water-cooled chiller efficiencies

Chillers on the market today offer a wide range of efficiencies, accounting for both full-load and part-load efficiencies. Strategies are categorized in the following manner:

- Baseline efficiency – Just meets the baseline protocol of the energy efficiency program; nearly all available equipment is able to meet this minimum
- Standard efficiency – Typical improvements without significant incremental cost.
- High efficiency – Incremental improvements beyond Standard efficiency through improved heat exchanger design, compressor technology or controls.
- Premium efficiency – At or near the top of the

include a cooling tower penalty to allow a direct comparison of these technologies. Most chillers will not provide capacity without cycling below around 20%-25% of full load capacity; as a result the diagram does not extend below 25% part load percent.

available equipment efficiency for these machines, typically at significant capital cost.

The diagram represents the current capability of these technologies. Please note that some premium efficiency air-cooled machines may outperform baseline or standard water-cooled machines at low part-load conditions.

Air-cooled chiller with improved performance: Air-cooled chillers use condenser fans to reject heat to the environment that include either screw or scroll compressor technologies, and may offer controls to match the compressor work efficiently to the load. The efficiency ratings for these chillers include the condenser fan energy at various tested load levels. The following table provides key characteristics for the baseline, standard, high and premium efficiency equipment at AHRI standard conditions.

Note that Energy Efficiency Ratio (EER) or kW/ton ratings above include power for the following:

	Compressor	Condenser fans	Evaporator fans	Pumps	Cooling Tower
Air cooled chiller	Yes	Yes	No	No	n/a
Water cooled chiller	Yes	n/a	No	No	No
Packaged DX rooftop	Yes	Yes	Yes	n/a	n/a
Split system	Yes	Yes	No	n/a	n/a

Strategy ID	Cooling Efficiency Strategies	Baseline	Strategy Efficiency	Reference Size Tons	Notes
MAC01	Air-cooled chiller, 5% decreased KW/ton	1.26 kW/ton	1.20 or lower	102	
MAC02	Air-cooled chiller, 13% decreased KW/ton	1.26 kW/ton	1.10 or lower	102	
MAC03	Air-cooled chiller, 20% decreased KW/ton	1.26 kW/ton	1.00 or lower	102	

Heating Efficiency Strategy Descriptions

Improved boiler efficiency: Change from a Baseline level boiler to a boiler that is more efficient. Two boiler efficiency improvements have been evaluated.

Condensing boiler with moderate temperature reset: This strategy uses condensing boilers with an efficiency range of 86% to 95%. Note that the condensing boilers

operate at the low end of their efficiency range during peak winter conditions and at the high end during mild heating conditions. In order to achieve these efficiencies, the entering boiler water temperature must be controlled to range from 160 F at peak winter conditions down to 130 F at mild conditions. A more aggressive temperature reset would result in more hours of operation near the high end of the efficiency range.

Strategy ID	Heating Efficiency Strategies	Baseline	Strategy Efficiency	Notes
MHT01	Gas boiler at 85% efficiency	80%	at least 85%	Combustion efficiency
MHT02	Condensing gas boiler at 95% efficiency	80%	at least 95%	AFUE

Base HVAC Efficiency Results

Key Points

- Ground-coupled water-to-water heat pump shows the highest potential for savings

This page intentionally left blank

Fan System Strategies

Strategy Objectives

Reduce the fan energy necessary to move design supply and return airflow to and from the conditioned spaces. As these selections are integrated with other building systems, study needs to be accomplished early in the design process.

Strategy Descriptions

Beyond premium efficiency motors: Motors exceeding the requirements of those mandated by the Energy Independence and Security Act of 2007. Please refer to the table at the end of this section.

Reduced fan system power: Fan power reduction strategies are design-specific, thus the potential savings associated with the options described below have been bracketed with fan system power reduction calculations of 10%, 20% and 30%. The following paragraphs provide approaches for the designer to consider.

- **Duct system design:** Typical galvanized sheet metal ducts lose static pressure proportional to the length from the fan. Some tools available to reduce friction losses are listed below.
  - *Increase cross-sections.* This effort brings the served spaces closer to the central fan when viewed from the fan static requirement. One trade off that needs to be considered is how this affects plenum size if floor-to-floor heights cannot be increased or the overall construction budget if the plenums are designed taller to accommodate this strategy.
  - *Specify low friction duct materials.* Reduce the friction factor compared with galvanized sheet metal.
  - *Improve duct aspect ratios.* Consider limiting the main branch duct cross section to a 1.5:1 or 2:1 ratio which will reduce turbulence and pressure loss near the central fan system outlet.
  - *Straighten out the transitions.* As the full capacity of air exits the supply fan, immediate transitions increase the turbulence in the duct. Design with a straight section at minimum 3X the largest dimension helps reduce the fan power. Adding flow straightener vanes at the first 90 degree elbow further assists static reduction.
  - *Reduce losses to plenum.* Leaky ducts will short circuit conditioned air back into the plenum, unnecessarily driving up fan powered needed to condition spaces.
  - *Reduce component pressure drops*. As the air passes through the fan system, it may encounter a number of conditioning elements such as VAV boxes, coils,

filters, dampers. Select air treatment components with improved flow characteristics to drop down the static pressure losses.

- **Fan system design:** The most basic fan configuration involves one fan that provides all supply, recirculation, ventilation and relief air flow to the building. While this may be energy efficient and cost effective, other options may provide incremental energy conservation benefits. The following section describes some options to consider.
  - *Adding a return fan.* This may allow for better balancing of the recirculated airflow even though another motor is added to the system.
  - *Two supply fans.* Often times these are added for redundancy where the building needs to function when a supply fan is under repair. However, the fan curves for the two fans at partial load may be more efficient than one supply fan sized to handle the capacity.
  - *Multiple fans for redundancy.* These systems offer even greater redundancy. In addition, while there are many more motors added, smaller motors may be controlled via direct-current rather than alternating-current. This may eliminate the need for a variable frequency drive to control capacity. The operating characteristics of these small fans need to be considered as smaller motors sometimes have higher inherent inefficiency.

- **Fan efficiency:** Select central fan components with improved operating efficiency. These may be accomplished through the design of the fan housing or the blade pitch. Careful selection nearest maximum efficiency can help reduce static losses inherent within the fan.

Strategy ID	Fan Strategies	Baseline	Strategy Level	Notes
MMT03	Exceeds Premium efficiency supply/return fan motors	Premium	Exceeds Premium	
MFD00	Baseline fan system power limitation	Section 6.5.3	Maximum allowed	1.22 bhp/1000cfm
MFD01	Fan system power at 1.11 bhp/1000 cfm	Section 6.5.3	10% reduction	1.11 bhp/1000 cfm
MFD02	Fan system power at 0.99 bhp/1000 cfm	Section 6.5.3	20% reduction	0.99 bhp/1000 cfm
MFD03	Fan system power at 0.87 bhp/1000 cfm	Section 6.5.3	30% reduction	0.87 bhp/1000 cfm

Fan System Results

Key Points

- Fan power reduction shows good potential for savings

This page intentionally left blank

Pump System Strategies

Strategy Objectives

Reduce the pump energy necessary to move hot or chilled water to and from the central or terminal heat exchangers. As these selections are integrated with other building systems, study needs to be accomplished early in the design process.

Strategy Descriptions

Variable frequency drive control: Install VFD control rather than constant speed drives on the secondary loop pump motors. This strategy assumes two-way valves on applicable hydronic system coils to reduce flowrate (modeled to minimum 30% flow) during periods of low load.

Variable frequency drives on pump motors with static pressure reset: For this strategy, a fixed head setpoint is not used. Instead the pumps are controlled so that the system head is just enough to provide the required flow to the worst-case coil, when that coil's control valve is fully open. This sequence minimizes the pump energy wasted through valve throttling.

Beyond premium efficiency motors: Motors exceeding the requirements of those mandated by the Energy Independence and Security Act of 2007. Please refer to the table at the end of this section.

Reduced pump System Power: Pump power reduction strategies are design-specific, thus the potential savings associated with the options described below have been bracketed with pump system power reduction calculations of 5%, 10%, 20% and 30%. The following paragraphs provide approaches for the designer to consider.

The following approaches may be used to reach these stretch goals.

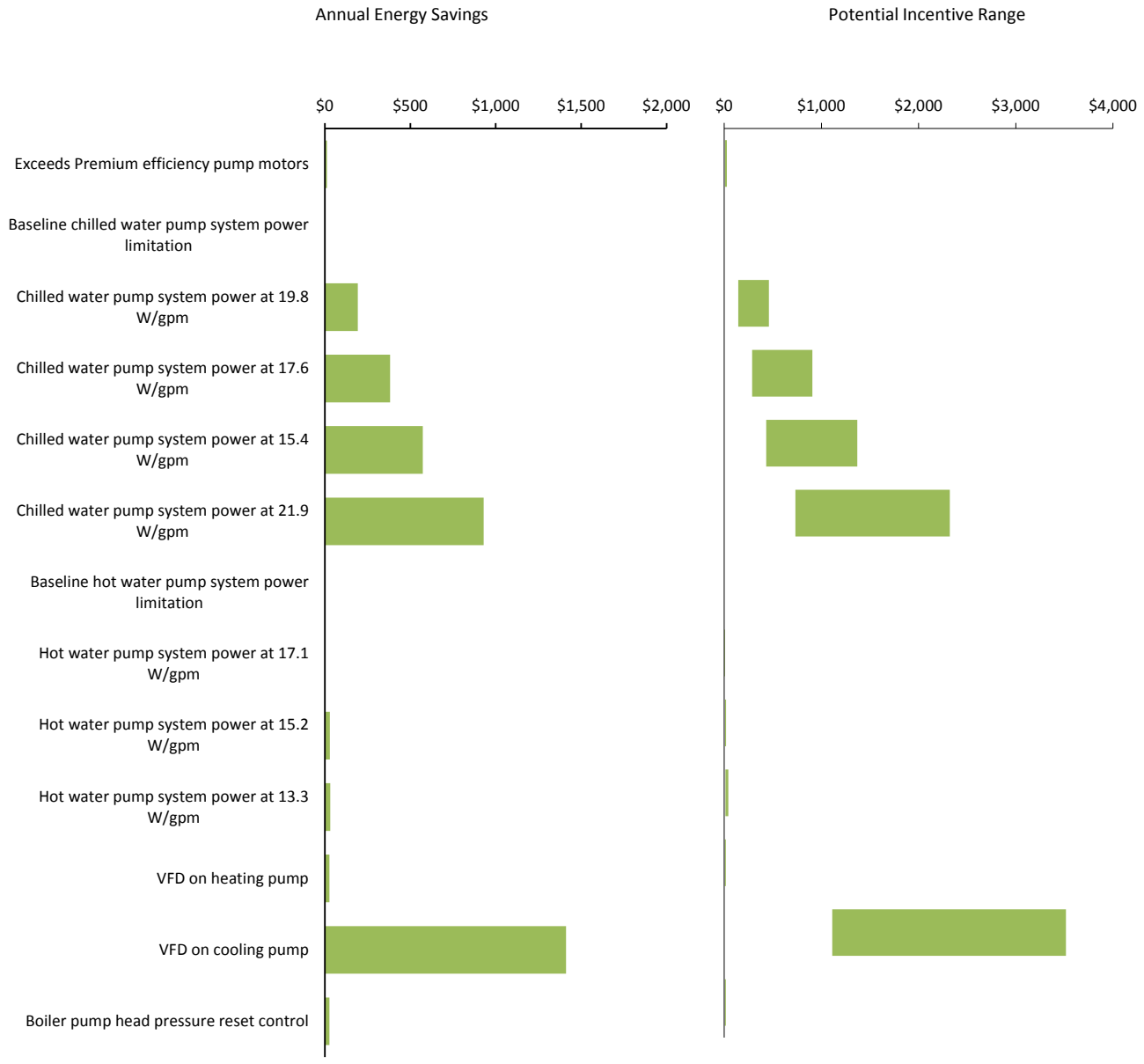
- **Piping System Design:** Piping loses static pressure proportional to the distance from the central pumping station. Below are some options to consider.
  - *Increase pipe size.* Essentially this effort brings the served spaces closer to the central pumping station when viewed from the system static requirement. One trade off that needs to be considered is how this affects space in the plenum as well as incremental pipe costs.
  - *Specify low friction pipe materials.* Reduce the friction factor compared with base material considered.

- *Reduce component pressure drops.* As the fluid passes through the pumping system, it may encounter elbows, valves, filters. Select components with improved flow characteristics to reduce static pressure losses.

- **Pump efficiency:** Select central station pumps with improved operating efficiency. These may be accomplished through careful selection of impeller size nearest maximum efficiency can help reduce static losses inherent within the pump.

Strategy ID	Pump Strategies	Baseline	Strategy Level	Notes
MMT04	Exceeds Premium efficiency pump motors	Premium	Exceeds Premium	
MPC00	Baseline chilled water pump system power limitation	Appendix G	22 W/gpm	
MPC01	Chilled water pump system power at 19.8 W/gpm	Appendix G	19.8 W/gpm	10% reduction
MPC02	Chilled water pump system power at 17.6 W/gpm	Appendix G	17.6 W/gpm	20% reduction
MPC03	Chilled water pump system power at 15.4 W/gpm	Appendix G	15.4 W/gpm	30% reduction
MPC04	Chilled water pump system power at 21.9 W/gpm	Appendix G	21.9 W/gpm	
MPH00	Baseline hot water pump system power limitation	Appendix G	19 W/gpm	
MPH01	Hot water pump system power at 17.1 W/gpm	Appendix G	17.1 W/gpm	10% reduction
MPH02	Hot water pump system power at 15.2 W/gpm	Appendix G	15.2 W/gpm	20% reduction
MPH03	Hot water pump system power at 13.3 W/gpm	Appendix G	13.3 W/gpm	30% reduction
MPP01	VFD on heating pump	pump curve	VFD	
MPP02	VFD on cooling pump	pump curve	VFD	
MPP03	Boiler pump head pressure reset control	const head	reset	

Pump System Results



Key Points

- Reduced chilled-water pump power shoes good potential for savings

Conditioning of Outside Air

Strategy Objectives

Reduce energy use by adjusting the volume of outside air that needs conditioning according to the actual building load or by recovering heat/cool from return air or equipment.

Strategy Descriptions

CO_2 sensor reset of minimum outside air: CO_2 sensors, located in the return air ducts (or the space), are used to reduce ventilation in proportion to the number of occupants served by a system. To implement this strategy, CO_2 sensors are added to the return air ducts (or to the space) as needed to ensure that concentrations in the building do not exceed threshold values. The CO_2 concentration threshold of roughly 1000 ppm provides ventilation of human and non-human source contaminants (e.g. VOCs, cleaning compounds, etc.). The strategy applies to all VAV air handlers in the building

CO control of garage ventilation fans: Carbon monoxide sensors are used to control the garage ventilation fans. The fans will cycle on to maintain carbon monoxide levels below a design threshold. The fans are forced to run at least 10 minutes per hour in order to vent any fumes from fuel or oil spills.

Total Energy Recovery: This strategy represents recovery of both sensible and latent heat from the exhaust air streams to the unconditioned ventilation air. This is typically accomplished using an enthalpy wheel or permeable membrane cross-flow heat exchanger. This strategy is assumed to have both sensible and latent effectiveness of 75% at design airflow and temperature, and applies to all VAV air handlers in the building. The strategy also assumes that 90% of the building exhaust volume is gathered for energy recovery use.

Strategy ID	Conditioning of Outside Air Strategies	Baseline	Strategy Level	Notes
MOA02	CO2 control of outside air	No control	CO2 control	
MOA22	Carbon monoxide sensor control of garage vent fans	Always on	CO control	
MHRT1	Total heat recovery	No recovery	75% Sensible	75% latent

Conditioning of Outside Air Results

Key Points

- Outside air control strategies show significant potential for savings

Service Water Heating (SWH) Strategies

Strategy Objectives

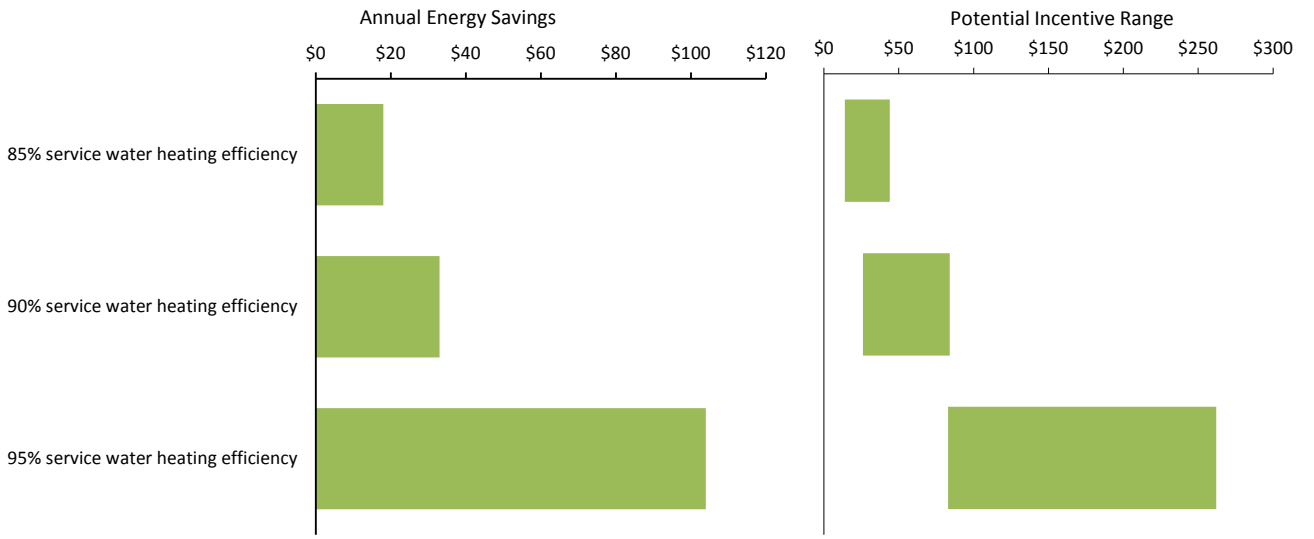
Reduce overall energy use of service water heating plant and distribution systems.

Strategy Description

Improved SWH efficiency: Install improved efficiency SWH systems as listed in the table below. Details of the base SWH system are provided with other building characteristics in the Appendices.

Strategy ID	Service Water Heating Strategies	Baseline	Strategy Level	Notes
MHW01	85% service water heating efficiency	80%	at least 85%	
MHW02	90% service water heating efficiency	80%	at least 90%	
MHW03	95% service water heating efficiency	80%	at least 95%	

Service Water Heating Strategy Results



Key Points

- Small annual gas energy savings are possible

Appendix A. Baseline Building Description

Item	Baseline	
Architectural		
Wall Assembly - Commercial	R-15.6 Assembly	Steel-framed
Roof Assembly - Commerical	R-20.8 Assembly	Insulation entirely above deck
Glazing Characteristics	N/A 0.55 0.40 0.41	U-factor COG U-factor Unit SHGC Vis. Trans.
Electrical		
Building Weighted Average Lighting Power Density	0.88	W/sf
Lighting Controls	Occupant sensor or time control required in classrooms, meeting, break, storage, small office, restrooms, and locker rooms. Lighting controlled with at least one step in all spaces except public areas. Refer to ASHRAE 90.1 for further detail.	
Exterior Lighting	17.95	kW
Plug Load Control	50% of the 125 volt receptacles for private offices and open offices must be automatically controlled	
Building Weighted Average Plug Load	0.73	w/sf

Item	Baseline
Mechanical	
Mechanical System Type	Packaged rooftop VAV with reheat, DX cooling and fossil fuel boiler
Total Supply CFM	52,479 CFM
% Outdoor Air CFM	20 %
Heating Efficiency	80 %
Cooling Efficiency	9.5 EER
Total Building Fan Power	1.22 bhp/1000 cfm_s
Total Pump Power	Boiler - 19 Chiller - 22 Watts/GPM

Appendix B. Building Characteristics

The following pages show some key building modeling parameters forwarded from the Design Team and incorporated into the energy model.

These parameters have been used to characterize the building in the DOE-2.2 model.

Building Location

Address:	1018 Woodbury Ave
City:	Council Bluffs
State:	Iowa

Envelope Characteristics

Select all envelope construction characteristics that apply

Walls	
Wood frame	
Steel frame	
Frame w/ masonry exterior	x
Masonry	
Metal	

Roof Construction	Select	Insulation Position
Wood Frame		
Steel Frame	x	A
Concrete		

Roof Insulation Position Key	
A	Entirely above deck/ continuous
B	Entirely below metal deck
C	Other/ Combination

Interior Floors	
Wood frame	
Steel frame	
Concrete	x

Window frame types	
Nonmetal	
Metal curtainwall/ storefront	x
Metal punched opening	x

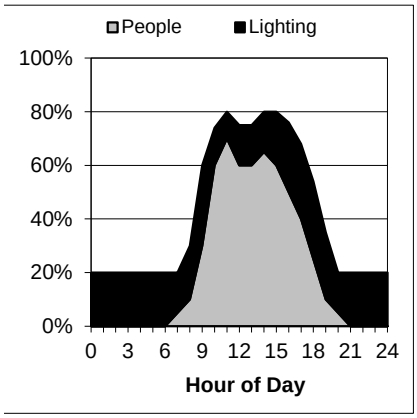
Window characteristics	Value
Total U-Factor (winter)	0.45
Center of glass U-Factor (winter)	0.31
Solar heat gain coefficient	0.29
Visible light transmittance	0.41

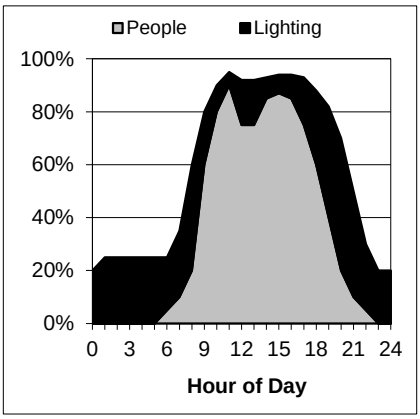
Window treatment (list building areas w/ blinds or shades)

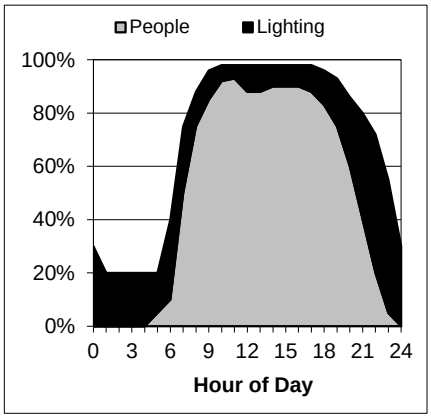
Building Operation Schedules

Select schedule that best describes operational use for lights and people use

Light Use	Medium Use		Heavy Use
	x		







Building Type: Office/Owner

MidAmerican Energy - Rate GD - General Demand Service

Fixed Monthly Charge	$20.00	per meter
Demand Charge - Summer	$7.07	per kW
Demand Charge - Winter	$6.77	per kW
Energy Charge - Summer	$0.07146	per kWh, first 200 hours * kW of demand
	$0.06118	per kWh, next 200 hours * kW of demand
	$0.05433	per kWh, over 400 hours * kW of demand
Energy Charge - Winter	$0.03767	per kWh, first 200 hours * kW of demand
	$0.03662	per kWh, next 200 hours * kW of demand
	$0.03558	per kWh, over 400 hours * kW of demand
Adjustments:		
Transmission Cost Adjustment	$ 0.69	per kW
Energy Adjustment Clause	($0.00201)	per kWh
Energy Efficiency Cost Recovery Adjustment	$0.00311	per kWh
Equalization Adjustment Clause	$0.00401	per kWh
Phase-In Adjustment Clause	$0.00000	per kWh
Carbon Reduction Rider	$0.00000	per kWh
Mitigation Cost Recovery Adjustment	$0.00000	per kWh

Please note that charges listed above do not include the tax adjustment charges, reactive demand charges, or service provided at primary voltage that may apply to this building. Please see tariff and riders for more information on those charges.

Summer months: June - September Winter months: October - May

Gas Rate Assumed for Model **

Natural gas consumption rate:	$0.755	per therm**

**Natural gas rates tend to fluctuate significantly from season to season, based on market pricing. The rate above is an arbitrary choice, with no particular prediction or endorsement of this rate by Black Hills Energy implied. The owner and design team may use this rate in this analysis, or suggest a rate based upon the teams' outlooks, with regard to gas futures.

Utility Service

Select all that apply:

- ☐ 120/240 V or 120/208 V, single phase service
- ☐ 277/460 V, three phase service
- ☐ High voltage service with primary metering (>600 V)

Space Type Building Characteristics

Enter design values.
If ceiling height is unknown, enter a safety factor value to allow for over-design.
If design reflectances are unknown, enter the assumed reflectances.
Horizonal footcandle levels will be used in daylighting strategies. IESNA FC levels are from the Ninth Edition IESNA Lighting Handbook.
Equip W/sf defines the average internal loads from computers, appliances,and production process within each space type. It should include factors for diversity, meaning it should be the peak value for a typical day.

Space Type	Ceiling Height FT	Design Reflectances			IESNA FC Level		Design FC Level		Equip W/SF		Percent of Equipment on 120 / 240 V Transformers
		Ceiling	Wall	Floor	Horiz	Vert	Horiz	Vert	Default	Actual	
Private office	9.0	80	50	20.0	30	5			1.20		
Open office	10.0	80	50	20.0	30	5			1.20		
Conference	10.0	80	50	20.0	30	5			0.50		
Briefing/Multi-Purp/Tactical	10.0	80	50	20.0	30	5			0.50		
Community room	10.0	80	50	20.0	30	5			0.50		
IT Equipment	12.0	20	50	20.0	3	3			12.00		
Corridor	9.0	80	50	20.0	5	10			0.10		
Lobby	14.0	80	50	20.0	10	3			0.25		
Storage	12.0	20	50	20.0	10	10			0.10		
Mech/elec	12.0	20	50	20.0	30	3			0.20		
Restroom	9.0	80	50	20.0	10	3			0.10		
Crime lab	10.0	80	50	20.0	50	30			3.00		
Exercise	12.0	20	50	20.0	30	5			0.10		
Sally Port	12.0	20	50	20.0	1	0.5			0.10		
Locker Room & Shower	9.0	80	50	20.0	5	3			0.50		
Break room	10.0	80	50	20.0	10	3			0.20		
Private Office 24/7	9.0	80	50	20.0	30	5			1.20		
Open office 24/7	10.0	80	50	20.0	30	5			1.20		
Corridor 24/7	9.0	80	50	20.0	5	10			0.10		
Conference 24/7	10.0	80	50	20.0	30	5			0.50		
Storage 24/7	12.0	20	50	20.0	10	10			0.10		

Exterior Lighting

90.1 Base Site Allowance of 750 Watts for tradable or non-tradable surfaces

	Spacetype	90.1 allowance		Unit for Info needed	Enter area or length	Total Design LPD	90.1 Baseline Lighting Power	Proposed Design Lighting Power
Tradable Areas	Uncovered Parking areas (parking lots and drives)	0.1	W/sq ft	Area (sq ft.)	130613	0.1	13061.3	13061.3
	Exterior walkways < 10ft. Wide	0.8	W/linear ft	Linear feet	200	0.8	160	160
	Exterior walkways 10ft. Or wider	0.16	W/sq ft	Area (sq ft.)	2540	0.16	406.4	406.4
	Plaza area	0.16	W/sq ft	Area (sq ft.)	6928	0.16	1108.48	1108.48
	Special Feature areas	0.16	W/sq ft	Area (sq ft.)				
	Stairways	1	W/sq ft	Area (sq ft.)				
	Pedestrian tunnels (2010 projects)	0.2	W/sq ft	Area (sq ft.)				
	Landscaping (2010 projects)	0.05	W/sq ft	Area (sq ft.)	1895	0.05	94.75	94.75
	Main building entries	30	W/linear ft of door width	Linear feet of door width	4	30	120	120
	Other building exterior doors	20	W/linear ft of door width	Linear feet of door width	31	20	620	620
	Canopies & Overhangs	0.4	W/sq ft	Area (sq ft.)	2240	0.4	896	896
	Free standing and attached sales canopies (2010 projects)	0.8	W/sq ft	Area (sq ft.)				
	Outdoor sales area	0.5	W/sq ft	Area (sq ft.)				
	Street frontage for vehicle sales	10	W/linear ft	Linear feet of street frontage				
Exempt Areas	Advertising signage	N/A		N/A	N/A		0	0
	Directional signage	N/A		N/A	N/A			
	Specialized signal, directional , and marker lighting associated with transportation	N/A		N/A	N/A		0	0
	Lighting for athletic playing areas	N/A		N/A	N/A			
Nontradable Areas	Building facades	3.75	W/linear ft	Linear feet of wall	35	3.75	131.25	131.25
	ATM machines and night depositories (first occurrence)	270	W per location	Number of locations				
	Addional ATMs	90	W per add'l ATM	Average number of			0	
	Uncovered entrances & gatehouse inspection stations at guarded facilities	0.75	W/sq ft	Area (sq ft.)	2	0.75		1.5
	Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5	W/sq ft	Area (sq ft.)	2700	0.5	1350	1350
	Drive-up windows at fast-food restaurants	400	W per drive-through	number of drive-				
	Parking near 24-hour retail entrances	800	W per main entry	number of main entries			0	

Service Water Heating System Characteristics	
Number of hot water heater units	2
Hot water tank size, gal per unit	50
Hot water heat source (Gas, Electric, or Steam)	gas
Hot water heater input rate (per unit, kBTU/hr)	76
Hot water system combustion efficiency (baseline)	80%
Hot water system combustion efficiency (design level)	90%
Hot water system supply temperature, deg F	140
Hot water circulation pump flow, gpm	8
Hot water circulation pump head, feet	33

Mechanical Zone Type Characteristics

• Enter or select actual values for each parameter, default values are approximate based on standard space type conditions

• Enter an "X" to identify what type of equipment will be used.

Space Type		Private office	Open office	Conference	Briefing/Multi-Purp/Tactical	Community room	IT Equipment	Corridor	Lobby	Storage	Mech/elec	Restroom	Crime lab	Exercise	Sally Port	Locker Room & Shower	Break room	Private Office 24/7	Open office 24/7	Corridor 24/7	Conference 24/7	Storage 24/7
Air Flow Type	CV																					
	VAV	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cooled Zone		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Heated Zone		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Perimeter Zones																						
Zones have fan powered boxes?																						
Terminal fan power (W/cfm)																						
Supply CFM/SF		1.20	0.82	1.35						0.74	0.61			1.20	1.05			1.20	0.82		1.35	0.74
Min CFM ratio	Default	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Design	0.39	0.27	0.39						0.61	0.19			0.31	0.35			0.39	0.27		0.39	0.61
Core zones																						
Zones have fan powered boxes?																						
Terminal fan power (W/cfm)																						
Supply CFM/SF		0.73	0.69	1.22	0.97	1.70	0.52	0.69	1.05	0.85	0.91	0.65	0.65			0.63		0.73	0.69	0.69	1.22	0.85
Min CFM ratio	Default	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Design	0.24	0.21	0.39	0.20	0.35	0.17	0.21	0.29	0.49	0.32	0.22	0.22			0.21		0.24	0.21	0.21	0.39	0.49
Ventilation																						
OA CFM/SF	Default	0.09	0.09	0.30	0.30	0.30	0.08	0.06	0.21	0.07	0.06	0.01	0.43	0.26	0.75	0.50	0.90	0.09	0.09	0.06	0.30	0.07
	Design	0.23	0.16	0.28	0.20	0.36	0.11	0.15	0.23	0.18	0.14	0.14	0.14	0.26	0.23	0.14		0.23	0.16	0.15	0.28	0.18
Zone heat source																						
HW coil		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
HW base board																						
Electric coil																						
Electric baseboard																						
Heat Pump																						
Gas furnace																						

Air handler and fan characteristics									
Air Handler Number	1	2	3	4	5	6	7	8	9
Region of building served	NW	SE	K9	Sally port	Maintenance	IT			
Air Handler Type	*Place an "X" for type*								
Central cooling/ terminal reheat									
Central cooling/ fan powered terminal reheat									
Four pipe fan coil									
Water loop heat pump									
Ground heat pump	x	x				x			
Packaged single zone units									
Packaged terminal A/C			x		x				
Heating and ventilation unit									
Dedicated outside air system (DOAS)									
Exhaust fan									
Fan Control	*Place an "X" for type*								
Constant volume			X	X	X	X			
Variable air volume	X	X							
Airflow Variables	*Enter data for each air handler*								
Supply cfm	20,000	20,000	700			9,000			
Minimum outdoor air cfm	4,300	4,300							
Design Min % outdoor air	22%	22%	0%			0%			
Is Outdoor air delivered by DOAS?									
Expected Exhaust cfm (1)									
(1) This is the expected exhaust from the air handler after accounting for building pressurization and toilet exhaust									
Economizer control	*Place an "X" for control type*								
None			x	x	x				
Air-side economizer (non-integrated)									
Air-side econo (integrated)	x	x				x			
Drycooler									
Water-side economizer									
Outdoor air control	*Place an "X" for control type; this applies to VAV systems only*								
Fixed cfm	X	X	X	X	X	X			
Proportional to supply cfm									
Conditioning of outdoor air	*Place an "X" if it applies to air handler*								
Energy recovery									
Demand Control Ventilation									
Total Fan Static estimate	*Note: Fan static values should include effects of ductwork, diffusers, coils, filters, etc*								
Total Supply (including filters), inches wc	3.00	3.00	0.50	2.00	1.00	2.00			
Filters only, inches wc (midlife)									
Total Return, inches wc	2.00	2.00	0.50	1.00	0.50	1.00			
Total Exhaust, inches wc									
Fan horsepower									
Supply fan hp									
Return fan hp									
Exhaust fan hp									
Supply fan bhp									
Return fan bhp									
Exhaust fan bhp									
Humidity Control	*Enter data for each air handler*								
Maximum setpoint									
Minimum setpoint									

Air handler and fan characteristics									
Air Handler Number	1	2	3	4	5	6	7	8	9
Region of building served	NW	SE	K9	Sally port	Maintenance	IT	0	0	0
Heating Plant / System	*Place an "X" for system type*								
Hot water coil									
Gas burner									
Electric resistance									
Heat pump									
Other:									
Cooling Plant / System	*Place an "X" for system type, for chiller systems make detailed entry in Plant form*								
No cooling									
Air cooled chiller									
Water cooled chiller									
Heat pump									
District cooling									
Direct expansion system data below									
Air cooled DX packaged or split									
Air cooled DX condensing units									
Evap. Cooled DX Rooftops									
Base design efficiency, EER									
- Include evaporator fan?									
Alternate design efficiency, EER									
- Include evaporator fan?									

Heat Recovery Characteristics

Sensible heat wheel		
Recovery effectiveness (winter)	68%	
Recovery effectiveness (summer)	68%	
Supply Static	0.5	
Exhaust Static	0.5	
Bypass when heat recovery not needed?	N	
Wheel motor hp	0.25	
Capacity/Frost control	**Capacity**	**Frost**
Wheel speed	X	X
Outside air bypass		
Exhaust air bypass		
Trim economizer		
No control		
Frost control calculation		
Keep exhaust air above 33 F		

Total enthalpy wheel		
Sensible effectiveness (winter)	75%	
Sensible effectiveness (summer)	75%	
Latent effectiveness	75%	
Supply Static	0.5	
Exhaust Static	0.5	
Bypass when heat recovery not needed?	Yes	
Wheel motor hp	0.25	
Capacity/Frost control	**Capacity**	**Frost**
Preheat outside air		
Preheat exhaust air		
Wheel speed		
Outside air bypass	X	X
Exhaust air bypass		
Trim economizer		
No control		
Frost control calculation		
Keep exhaust air above 33 F		
Based on winter design OA condition		
Done by real time calculations	X	

Boiler Plant Characteristics			Mech No Strat	
Strategy Description	Standard Boiler	Condensing Boiler	Boiler	Baseline
Names systems served (or ALL)		Heating loop	0	
Type (water, steam, etc)		Water	water	water
Number of units		1	1	1
Output per unit (KBTU/HR)		376	1226.7	1226.7
Total output (KBTU/HR)		376	1226.7	1226.7
Fuel Source (Gas, electric, etc)		Gas	Gas	Gas
Rated supply water temperature			180	180
< or > Rated return water temperature				
Thermal efficiency at rated supply T		94%	80%	80%
< or > Combustion efficiency at rated supply T				
Boiler AFUE				
Condensing boiler? (Y or N)	N	Y	N	N
Delta T at capacity		20	50	50
Temperature reset strategy				
Reset boiler supply temp based on outside air temp?			Y	Y
Lower limit outside temp			20	20
Boiler supply temp at low outside temp			180	180
High limit outside temp			50	50
Boiler supply temp at high outside temp			150	150
Primary circulation loop (connects to boilers)				
Indicate the primary pump configuration by marking with "X"				
Each boiler has its own pump		x	X	X
A single pump in the primary loop serves all boilers			0	
A bank of pumps in the primary loop serves all boilers			0	
Number of primary pumps		1	1	1
Primary pump head (ft water)		14.1	70	70
Primary pump GPM (total of all pumps)		60	0	0
Primary pumps have VFDs? (Y or N)		N	Y	Y
Primary loop min flow ratio		0.4	0.5	0.5
Primary pumps use head pressure reset control? (Y or N)		N	N	N
Secondary circulation loop (where applicable - connects to building load)				
Number of secondary pumps			0	0
Secondary pump head (ft water)			0	0
Secondary pump GPM (total of all pumps)			0	0
Secondary pumps have VFDs?			N	N
Secondary loop min flow ratio			0.5	0.5
Secondary pumps use head pressure reset control? (Y or N)			N	N

Chiller Plant Strategies Chiller Plant	MAC01	MAC02	MAC03	Mech No Strat Chiller	Baseline
Chiller Type Name	screw	screw	screw	screw	screw
Open or Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Air or Water Cooled	air	air	air	air	water
Standard, VFD or Frictionless	Standard	Standard	Standard		
Number of units	1	1	1	1	1
Itemized cooling tons	75	75	75	102	102
Total cooling tons	75	75	75	102	102
KW/ton at AHRI rated conditions *				1.26	0.775
Items below refer to chiller system at design operating conditions					
KW/ton at design conditions *					
Design evaporator leaving water temperature	44	44	45	44	44
Design entering condenser temp (Entering water for cooling tower, outdoor air for air-cooled)	85	85	85	85	85
Chilled water supply temperature reset strategy					
Reset based on load (via return T or valve positions)?				N	N
Reset based on outside air temp?				Y	Y
Lower limit outside air temp				60	60
Chilled water supply temp at low OA temp				54	54
High limit outside air temp				80	80
Chilled water supply temp at high OA temp				44	44
Primary chilled water loop (connected directly to chiller)					
Indicate the primary pump configuration by marking with "X"					
Each chiller has its own pump					X
A single primary pump serves all chillers	X	X	X	X	
A bank of pumps in the primary loop serves all chillers					
Number of primary pumps	1	1	1	1	1
Primary pump head (ft water)	40	40	40	80.8	40.4
Primary chiller gpm/ton	2.56	2.56	2.56	2.56	2
Primary pumps have VFDs? (Y or N)	Y	Y	Y	N	N
Primary loop minimum flow ratio	0.25	0.25	0.25	1.0	1.0
Primary pumps use head pressure reset control?				N	N
Secondary chilled water loop (where applicable, connects to building load)					
Number of secondary pumps	0	0	0	0	0
Secondary pump head (ft water)				0.0	40.4
Secondary pump gpm/ton				2	2
Secondary pumps have VFDs?				N	N
Secondary loop minimum flow ratio				0.5	0.5
Secondary pumps use head pressure reset control?				N	N

** KW/ton is compressor only for water cooled units, compressor + condenser fan for air cooled*

Additional water-to-water heat pump characteristics	
Number of water-to-water units	1
Capacity for cooling (Total Tons)	75
EER rating for cooling	16.6
Entering water temperature from well for cooling (°F)	77
Chilled water design setpoint (°F)	44
Capacity for heating (Total Tons)	32.4
COP rating for heating	3.7
Entering water temperature from well for heating (°F)	54
Heating water design setpoint (°F)	130
Chilled water primary pump (attaches to HP)	
Number of pumps	1
Pump head, ft water	40
Primary pump gpm/ton	2.56
Pumps have VFDs? (Y or N)	Y
Primary loop min flow ratio	0.25
Pumps use head pressure reset control? (Y or N)	N
Chilled water secondary pump (where applicable, attaches to building loads)	
Number of pumps	1
Pump head, ft water	40
Secondary pump gpm/ton	2.56
Pumps have VFDs? (Y or N)	Y
Primary loop min flow ratio	0.25
Pumps use head pressure reset control? (Y or N)	N
Heating water primary pump (attaches to HP)	
Number of pumps	1
Pump head, ft water	35
GPM (total of all pumps)	130
Pumps have VFDs? (Y or N)	Y
Primary loop min flow ratio	0.25
Pumps use head pressure reset control? (Y or N)	
Heating water secondary pump (where applicable, attaches to building loads)	
Number of pumps	
Pump head, ft water	
GPM (total of all pumps)	
Pumps have VFDs? (Y or N)	
Primary loop min flow ratio	
Pumps use head pressure reset control? (Y or N)	
Well loop pump	
Number of pumps	1
Total Pump head, ft water	85
Static head, ft water (for open systems)	
GPM (total of all pumps)	260
Pumps have VFDs? (Y or N)	Y
Primary loop min flow ratio	0.25
Pumps use head pressure reset control? (Y or N)	

Appendix C. Detailed Results

The following pages provide detailed energy analysis results in terms of cost, consumption, and demand calculations for the base building, bundles, and all strategies.

City of Council Bluffs Police Headquarters

Energy Costs

55,690 SQ.FT.

Strategy	Itemized Costs						Totals per bldg sq. ft			Totals for Building	
	Heating $/sf	Cooling $/sf	Fan/ pump $/sf	SWH $/sf	Lights $/sf	Equip $/sf	Annual Energy $/sf	Annual Savings $/sf	% $ Savings	Energy $/yr	Annual Savings
Baseline; CODE1	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**			**$77,904**	
Utility Protocol Baseline; UTL01	$.395	$.192	$.169	$.005	$.325	$.228	**$1.32**			**$73,236**	
Bundle 1; BND01	$.147	$.110	$.117	$.004	$.214	$.228	**$.82**	$0.49	37.6%	**$45,700**	**$27,536**
Bundle 2; BND02	$.140	$.105	$.107	$.004	$.156	$.228	**$.74**	$0.58	43.8%	**$41,183**	**$32,053**
Bundle 3; BND03	$.141	$.096	$.088	$.004	$.137	$.228	**$.69**	$0.62	47.2%	**$38,639**	**$34,597**
R-16 wall assembly; EWC01	$.539	$.131	$.151	$.005	$.326	$.229	**$1.38**	$0.02	1.2%	**$76,989**	**$915**
R-20 wall assembly; EWC02	$.532	$.131	$.151	$.005	$.326	$.229	**$1.38**	$0.02	1.7%	**$76,597**	**$1,307**
R-24 roof assembly; ERC01	$.549	$.131	$.151	$.005	$.326	$.229	**$1.39**	$0.01	0.5%	**$77,533**	**$371**
R-30 roof assembly; ERC02	$.543	$.130	$.150	$.005	$.326	$.229	**$1.38**	$0.02	1.1%	**$77,064**	**$840**
R-40 roof assembly; ERC03	$.536	$.130	$.150	$.005	$.326	$.229	**$1.38**	$0.02	1.6%	**$76,621**	**$1,283**
White roof; EWRF1	$.560	$.131	$.151	$.005	$.326	$.229	**$1.40**	($0.00)	-0.2%	**$78,053**	**($149)**
Low-E clear 1/ alum frame; W0601	$.519	$.137	$.155	$.005	$.327	$.229	**$1.37**	$0.03	1.8%	**$76,465**	**$1,439**
Low-E tint 1/ alum frame; W0901	$.539	$.132	$.152	$.005	$.326	$.229	**$1.38**	$0.02	1.1%	**$77,037**	**$867**
Low-E clear, high visible transmittance/ alum frame; W1201	$.540	$.132	$.151	$.005	$.326	$.229	**$1.38**	$0.02	1.1%	**$77,028**	**$876**
Low-E tint, high visible transmittance/ alum frame; W1301	$.549	$.130	$.150	$.005	$.325	$.229	**$1.39**	$0.01	0.8%	**$77,311**	**$593**
Design glazing; W6801	$.556	$.129	$.149	$.005	$.326	$.229	**$1.40**	$0.00	0.3%	**$77,694**	**$210**
No Daylighting ; D3401	$.550	$.133	$.152	$.005	$.338	$.229	**$1.41**	($0.01)	-0.6%	**$78,344**	**($440)**
Stepped daylighting controls; D3402	$.556	$.131	$.150	$.005	$.322	$.229	**$1.39**	$0.00	0.3%	**$77,640**	**$264**
Dimming daylighting controls w/ LEDs; D3403	$.564	$.129	$.149	$.005	$.296	$.229	**$1.37**	$0.03	1.9%	**$76,432**	**$1,472**
Private office vacancy sensor control; LCPO8	$.555	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.1%	**$77,844**	**$60**
Open office vacancy sensor control; LCOO8	$.563	$.131	$.151	$.005	$.310	$.229	**$1.39**	$0.01	0.6%	**$77,401**	**$503**
Conference vacancy sensor control; LCCN8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.1%	**$77,864**	**$40**
Briefing/Multi-Purp/Tactical vacancy sensor control; LCCM8	$.555	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.1%	**$77,801**	**$103**
Community room vacancy sensor control; LCCG8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,892**	**$12**
IT Equipment vacancy sensor control; LCDC8	$.555	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.2%	**$77,786**	**$118**
Corridor occupancy sensor control; LCCI1	$.556	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.1%	**$77,857**	**$47**
Corridor vacancy sensor control; LCCI8	$.556	$.132	$.151	$.005	$.324	$.229	**$1.40**	$0.00	0.1%	**$77,836**	**$68**
Lobby occupancy sensor control; LCLO1	$.542	$.130	$.152	$.005	$.322	$.229	**$1.38**	$0.02	1.3%	**$76,863**	**$1,041**
Lobby vacancy sensor control; LCLO8	$.538	$.129	$.152	$.005	$.321	$.229	**$1.37**	$0.03	1.8%	**$76,511**	**$1,393**
Storage vacancy sensor control; LCST8	$.556	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.1%	**$77,849**	**$55**
Mech/elec vacancy sensor control; LCME8	$.559	$.132	$.151	$.005	$.318	$.229	**$1.39**	$0.00	0.3%	**$77,664**	**$240**
Restroom vacancy sensor control; LCRR8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,890**	**$14**
Crime lab occupancy sensor control to 1/3 level; LCLB2	$.555	$.132	$.151	$.005	$.323	$.229	**$1.39**	$0.00	0.3%	**$77,669**	**$235**
Crime lab vacancy sensor control; LCLB8	$.555	$.132	$.151	$.005	$.322	$.229	**$1.39**	$0.01	0.4%	**$77,605**	**$299**
Exercise vacancy sensor control; LCFT8	$.556	$.132	$.151	$.005	$.324	$.229	**$1.40**	$0.00	0.1%	**$77,833**	**$71**
Locker Room & Shower vacancy sensor control; LCLR8	$.556	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.0%	**$77,867**	**$37**
Break room manual dimming; LCDN5	$.552	$.132	$.152	$.005	$.326	$.229	**$1.40**	$0.00	0.2%	**$77,718**	**$186**
Break room vacancy sensor control; LCDN8	$.553	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.2%	**$77,710**	**$194**
Private Office 24/7 vacancy sensor control; LCOF8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.1%	**$77,855**	**$49**

City of Council Bluffs Police Headquarters

Energy Costs

55,690 SQ.FT.

Strategy	Itemized Costs						Totals per bldg sq. ft			Totals for Building	
	Heating $/sf	Cooling $/sf	Fan/ pump $/sf	SWH $/sf	Lights $/sf	Equip $/sf	Annual Energy $/sf	Annual Savings $/sf	% $ Savings	Energy $/yr	Annual Savings
Baseline; CODE1	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**			**$77,904**	
Open office 24/7 vacancy sensor control; LCOP8	$.559	$.130	$.150	$.005	$.307	$.229	**$1.38**	$0.02	1.3%	**$76,860**	**$1,044**
Corridor 24/7 occupancy sensor control; LCCR1	$.557	$.132	$.151	$.005	$.325	$.229	**$1.40**	$0.00	0.0%	**$77,895**	**$9**
Corridor 24/7 vacancy sensor control; LCCR8	$.557	$.132	$.151	$.005	$.324	$.229	**$1.40**	$0.00	0.0%	**$77,867**	**$37**
Conference 24/7 vacancy sensor control; LCCF8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,895**	**$9**
Storage 24/7 vacancy sensor control; LCSR8	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,903**	**$1**
Building wide 30% lower than 90.1-2010; L01BW	$.555	$.122	$.148	$.005	$.240	$.229	**$1.30**	$0.10	7.1%	**$72,336**	**$5,568**
Building wide 40% lower than 90.1-2010; L02BW	$.556	$.119	$.147	$.005	$.211	$.229	**$1.27**	$0.13	9.4%	**$70,560**	**$7,344**
Building wide 50% lower than 90.1-2010; L03BW	$.557	$.116	$.146	$.005	$.183	$.229	**$1.24**	$0.16	11.6%	**$68,876**	**$9,028**
Air-cooled chiller, 5% decreased KW/ton; MAC01	$.553	$.129	$.138	$.005	$.326	$.229	**$1.38**	$0.02	1.3%	**$76,862**	**$1,042**
Air-cooled chiller, 13% decreased KW/ton; MAC02	$.551	$.128	$.137	$.005	$.326	$.229	**$1.38**	$0.02	1.6%	**$76,675**	**$1,229**
Air-cooled chiller, 20% decreased KW/ton; MAC03	$.549	$.127	$.136	$.005	$.326	$.229	**$1.37**	$0.03	1.9%	**$76,461**	**$1,443**
Gas boiler at 85% efficiency; MHT01	$.552	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.2%	**$77,739**	**$165**
Condensing gas boiler at 95% efficiency; MHT02	$.547	$.132	$.150	$.005	$.326	$.229	**$1.39**	$0.01	0.7%	**$77,389**	**$515**
Water-to-water heat pump (sizing run); MPR01	$.109	$.191	$.561	$.005	$.326	$.229	**$1.42**	($0.02)	-1.6%	**$79,161**	**($1,257)**
Water-to-water heat pump; MWW01	$.187	$.137	$.137	$.005	$.326	$.229	**$1.02**	$0.38	26.9%	**$56,918**	**$20,986**
Exceeds Premium efficiency supply/return fan motors; MMT03	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.1%	**$77,862**	**$42**
Baseline fan system power limitation; MFD00	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,904**	**$0**
Fan system power at 1.11 bhp/1000 cfm; MFD01	$.556	$.131	$.141	$.005	$.326	$.229	**$1.39**	$0.01	0.8%	**$77,302**	**$602**
Fan system power at 0.99 bhp/1000 cfm; MFD02	$.557	$.129	$.131	$.005	$.326	$.229	**$1.38**	$0.02	1.5%	**$76,724**	**$1,180**
Fan system power at 0.87 bhp/1000 cfm; MFD03	$.558	$.128	$.121	$.005	$.326	$.229	**$1.37**	$0.03	2.3%	**$76,142**	**$1,762**
Exceeds Premium efficiency pump motors; MMT04	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,892**	**$12**
Baseline chilled water pump system power limitation; MPC00	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,904**	**$0**
Chilled water pump system power at 19.8 W/gpm; MPC01	$.555	$.131	$.149	$.005	$.326	$.229	**$1.40**	$0.00	0.2%	**$77,711**	**$193**
Chilled water pump system power at 17.6 W/gpm; MPC02	$.554	$.131	$.146	$.005	$.326	$.229	**$1.39**	$0.01	0.5%	**$77,522**	**$382**
Chilled water pump system power at 15.4 W/gpm; MPC03	$.554	$.130	$.143	$.005	$.326	$.229	**$1.39**	$0.01	0.7%	**$77,331**	**$573**
Chilled water pump system power at 21.9 W/gpm; MPC04	$.554	$.129	$.138	$.005	$.326	$.229	**$1.38**	$0.02	1.2%	**$76,975**	**$929**
Baseline hot water pump system power limitation; MPH00	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,904**	**$0**
Hot water pump system power at 17.1 W/gpm; MPH01	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,902**	**$2**
Hot water pump system power at 15.2 W/gpm; MPH02	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,875**	**$29**
Hot water pump system power at 13.3 W/gpm; MPH03	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,873**	**$31**
VFD on heating pump; MPP01	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,877**	**$27**
VFD on cooling pump; MPP02	$.553	$.128	$.132	$.005	$.326	$.229	**$1.37**	$0.03	1.8%	**$76,493**	**$1,411**
Boiler pump head pressure reset control; MPP03	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,877**	**$27**
CO2 control of outside air; MOA02	$.538	$.121	$.143	$.005	$.326	$.229	**$1.36**	$0.04	2.6%	**$75,903**	**$2,001**
Carbon monoxide sensor control of garage vent fans; MOA22	$.548	$.132	$.151	$.005	$.326	$.229	**$1.39**	$0.01	0.5%	**$77,548**	**$356**
Total heat recovery; MHRT1	$.535	$.122	$.147	$.005	$.326	$.229	**$1.37**	$0.03	2.4%	**$76,033**	**$1,871**
85% service water heating efficiency; MHW01	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,886**	**$18**
90% service water heating efficiency; MHW02	$.555	$.132	$.151	$.005	$.326	$.229	**$1.40**	$0.00	0.0%	**$77,871**	**$33**
95% service water heating efficiency; MHW03	$.555	$.132	$.151	$.004	$.326	$.229	**$1.40**	$0.00	0.1%	**$77,800**	**$104**

City of Council Bluffs Police Headquarters

Annual Energy by End Use

55,690 SQ.FT.

	Itemized KBtu/sf						Totals	
Strategy	Heat	Cool	Fan/ Pump	SWH	Lights	Equip	Total KBtu/sf	Savings
Baseline; CODE1	33.1	6.5	7.5	0.7	16.1	11.3	75.21	
Utility Protocol Baseline; UTL01	23.8	9.5	8.4	0.7	16.1	11.3	69.76	
Bundle 1; BND01	9.8	5.4	5.7	0.5	10.5	11.3	43.01	38.3%
Bundle 2; BND02	8.6	5.0	5.1	0.5	7.5	11.3	38.02	45.5%
Bundle 3; BND03	8.9	4.6	4.2	0.5	6.6	11.3	36.06	48.3%
R-16 wall assembly; EWC01	31.4	6.5	7.4	0.7	16.1	11.3	73.42	2.4%
R-20 wall assembly; EWC02	30.6	6.4	7.4	0.7	16.1	11.3	72.61	3.5%
R-24 roof assembly; ERC01	32.5	6.5	7.4	0.7	16.1	11.3	74.54	0.9%
R-30 roof assembly; ERC02	31.7	6.4	7.4	0.7	16.1	11.3	73.64	2.1%
R-40 roof assembly; ERC03	31.0	6.4	7.4	0.7	16.1	11.3	72.84	3.2%
White roof; EWRF1	33.5	6.5	7.4	0.7	16.1	11.3	75.45	-0.3%
Low-E clear 1/ alum frame; W0601	30.3	6.7	7.6	0.7	16.1	11.3	72.64	3.4%
Low-E tint 1/ alum frame; W0901	31.7	6.5	7.5	0.7	16.1	11.3	73.75	1.9%
Low-E clear, high visible transmittance/ alum frame; W1201	31.7	6.5	7.5	0.7	16.1	11.3	73.67	2.1%
Low-E tint, high visible transmittance/ alum frame; W1301	32.4	6.4	7.4	0.7	16.1	11.3	74.27	1.3%
Design glazing; W6801	33.0	6.4	7.4	0.7	16.1	11.3	74.82	0.5%
No Daylighting ; D3401	32.8	6.5	7.5	0.7	16.6	11.3	75.44	-0.3%
Stepped daylighting controls; D3402	33.3	6.5	7.4	0.7	15.9	11.3	75.05	0.2%
Dimming daylighting controls w/ LEDs; D3403	33.8	6.4	7.4	0.7	14.7	11.3	74.24	1.3%
Private office vacancy sensor control; LCPO8	33.2	6.5	7.5	0.7	16.0	11.3	75.19	0.0%
Open office vacancy sensor control; LCOO8	33.7	6.5	7.4	0.7	15.2	11.3	74.83	0.5%
Conference vacancy sensor control; LCCN8	33.2	6.5	7.5	0.7	16.1	11.3	75.19	0.0%
Briefing/Multi-Purp/Tactical vacancy sensor control; LCCM8	33.1	6.5	7.5	0.7	16.0	11.3	75.13	0.1%
Community room vacancy sensor control; LCCG8	33.2	6.5	7.5	0.7	16.1	11.3	75.20	0.0%
IT Equipment vacancy sensor control; LCDC8	33.1	6.5	7.4	0.7	16.0	11.3	75.09	0.2%
Corridor occupancy sensor control; LCCI1	33.2	6.5	7.5	0.7	16.0	11.3	75.20	0.0%
Corridor vacancy sensor control; LCCI8	33.3	6.5	7.5	0.7	16.0	11.3	75.19	0.0%
Lobby occupancy sensor control; LCLO1	32.2	6.4	7.5	0.7	15.9	11.3	73.94	1.7%
Lobby vacancy sensor control; LCLO8	31.8	6.4	7.5	0.7	15.8	11.3	73.43	2.4%
Storage vacancy sensor control; LCST8	33.2	6.5	7.5	0.7	16.0	11.3	75.19	0.0%
Mech/elec vacancy sensor control; LCME8	33.5	6.5	7.5	0.7	15.7	11.3	75.14	0.1%
Restroom vacancy sensor control; LCRR8	33.2	6.5	7.5	0.7	16.1	11.3	75.20	0.0%
Crime lab occupancy sensor control to 1/3 level; LCLB2	33.2	6.5	7.4	0.7	15.9	11.3	75.01	0.3%
Crime lab vacancy sensor control; LCLB8	33.2	6.5	7.4	0.7	15.9	11.3	74.96	0.3%
Exercise vacancy sensor control; LCFT8	33.3	6.5	7.5	0.7	16.0	11.3	75.18	0.0%
Locker Room & Shower vacancy sensor control; LCLR8	33.2	6.5	7.5	0.7	16.0	11.3	75.19	0.0%
Break room manual dimming; LCDN5	32.8	6.5	7.5	0.7	16.1	11.3	74.84	0.5%
Break room vacancy sensor control; LCDN8	32.9	6.5	7.5	0.7	16.0	11.3	74.88	0.4%
Private Office 24/7 vacancy sensor control; LCOF8	33.2	6.5	7.5	0.7	16.1	11.3	75.20	0.0%

City of Council Bluffs Police Headquarters

Annual Energy by End Use

55,690 SQ.FT.

	Itemized KBtu/sf						Totals	
Strategy	Heat	Cool	Fan/ Pump	SWH	Lights	Equip	Total KBtu/sf	Savings
Baseline; CODE1	33.1	6.5	7.5	0.7	16.1	11.3	75.21	
Open office 24/7 vacancy sensor control; LCOP8	33.4	6.4	7.4	0.7	15.1	11.3	74.22	1.3%
Corridor 24/7 occupancy sensor control; LCCR1	33.2	6.5	7.5	0.7	16.0	11.3	75.20	0.0%
Corridor 24/7 vacancy sensor control; LCCR8	33.3	6.5	7.5	0.7	16.0	11.3	75.21	0.0%
Conference 24/7 vacancy sensor control; LCCF8	33.2	6.5	7.5	0.7	16.1	11.3	75.20	0.0%
Storage 24/7 vacancy sensor control; LCSR8	33.2	6.5	7.5	0.7	16.1	11.3	75.21	0.0%
Building wide 30% lower than 90.1-2010; L01BW	33.0	6.0	7.3	0.7	11.9	11.3	70.21	6.7%
Building wide 40% lower than 90.1-2010; L02BW	32.9	5.9	7.3	0.7	10.5	11.3	68.53	8.9%
Building wide 50% lower than 90.1-2010; L03BW	33.0	5.8	7.2	0.7	9.1	11.3	66.98	10.9%
Air-cooled chiller, 5% decreased KW/ton; MAC01	33.1	6.4	6.8	0.7	16.1	11.3	74.45	1.0%
Air-cooled chiller, 13% decreased KW/ton; MAC02	33.1	6.4	6.8	0.7	16.1	11.3	74.43	1.0%
Air-cooled chiller, 20% decreased KW/ton; MAC03	33.1	6.3	6.8	0.7	16.1	11.3	74.38	1.1%
Gas boiler at 85% efficiency; MHT01	32.8	6.5	7.5	0.7	16.1	11.3	74.82	0.5%
Condensing gas boiler at 95% efficiency; MHT02	32.1	6.5	7.4	0.7	16.1	11.3	74.13	1.4%
Water-to-water heat pump (sizing run); MPR01	7.1	9.7	28.5	0.7	16.1	11.3	73.37	2.4%
Water-to-water heat pump; MWW01	14.5	6.5	6.5	0.7	16.1	11.3	55.54	26.2%
Exceeds Premium efficiency supply/return fan motors; MMT03	33.1	6.5	7.4	0.7	16.1	11.3	75.17	0.1%
Baseline fan system power limitation; MFD00	33.1	6.5	7.5	0.7	16.1	11.3	75.21	0.0%
Fan system power at 1.11 bhp/1000 cfm; MFD01	33.2	6.4	7.0	0.7	16.1	11.3	74.70	0.7%
Fan system power at 0.99 bhp/1000 cfm; MFD02	33.3	6.4	6.5	0.7	16.1	11.3	74.19	1.4%
Fan system power at 0.87 bhp/1000 cfm; MFD03	33.3	6.3	6.0	0.7	16.1	11.3	73.68	2.0%
Exceeds Premium efficiency pump motors; MMT04	33.1	6.5	7.4	0.7	16.1	11.3	75.20	0.0%
Baseline chilled water pump system power limitation; MPC00	33.1	6.5	7.5	0.7	16.1	11.3	75.21	0.0%
Chilled water pump system power at 19.8 W/gpm; MPC01	33.1	6.5	7.3	0.7	16.1	11.3	75.06	0.2%
Chilled water pump system power at 17.6 W/gpm; MPC02	33.1	6.5	7.2	0.7	16.1	11.3	74.92	0.4%
Chilled water pump system power at 15.4 W/gpm; MPC03	33.1	6.4	7.1	0.7	16.1	11.3	74.77	0.6%
Chilled water pump system power at 21.9 W/gpm; MPC04	33.1	6.4	6.8	0.7	16.1	11.3	74.46	1.0%
Baseline hot water pump system power limitation; MPH00	33.1	6.5	7.5	0.7	16.1	11.3	75.21	0.0%
Hot water pump system power at 17.1 W/gpm; MPH01	33.2	6.5	7.5	0.7	16.1	11.3	75.21	0.0%
Hot water pump system power at 15.2 W/gpm; MPH02	33.2	6.5	7.4	0.7	16.1	11.3	75.20	0.0%
Hot water pump system power at 13.3 W/gpm; MPH03	33.2	6.5	7.4	0.7	16.1	11.3	75.21	0.0%
VFD on heating pump; MPP01	33.2	6.5	7.4	0.7	16.1	11.3	75.20	0.0%
VFD on cooling pump; MPP02	33.1	6.3	6.5	0.7	16.1	11.3	74.08	1.5%
Boiler pump head pressure reset control; MPP03	33.2	6.5	7.4	0.7	16.1	11.3	75.20	0.0%
CO2 control of outside air; MOA02	31.7	6.0	7.1	0.7	16.1	11.3	72.98	3.0%
Carbon monoxide sensor control of garage vent fans; MOA22	32.5	6.5	7.4	0.7	16.1	11.3	74.56	0.9%
Total heat recovery; MHRT1	31.8	6.1	7.4	0.7	16.1	11.3	73.45	2.3%
85% service water heating efficiency; MHW01	33.1	6.5	7.5	0.7	16.1	11.3	75.17	0.0%
90% service water heating efficiency; MHW02	33.1	6.5	7.5	0.6	16.1	11.3	75.14	0.1%
95% service water heating efficiency; MHW03	33.1	6.5	7.5	0.5	16.1	11.3	74.98	0.3%

City of Council Bluffs Police Headquarters

Peak Conditions

55,690 SQ.FT.

	Peak Electric				Gas		Cooling				Heating		
	Peak W/sf	Peak kW	kW Savings	% kW Savings	Peak gas KBTU/H	% peak gas savings	Cooling sf/ton	Cooling tons	Peak cooling savings	Possible cooling % downsize	Heating KBTU/H	Peak heating savings	Possible heating % downsize
Baseline; CODE1	4.0	223			830		631	88			980		
Utility Protocol Baseline; UTL01	3.7	206			920		635	88			1,003		
Bundle 1; BND01	2.4	136	70	34%	580	37%	821	68	20	23.0%	735	268	27.0%
Bundle 2; BND02	2.3	126	80	39%	570	38%	860	65	23	26.0%	731	272	27.0%
Bundle 3; BND03	2.0	114	92	45%	530	42%	978	57	31	35.0%	672	331	33.0%
R-16 wall assembly; EWC01	4.0	222	1	0%	790	5%	636	88	0	0.0%	937	43	4.0%
R-20 wall assembly; EWC02	4.0	222	1	0%	770	7%	639	87	1	1.0%	907	73	7.0%
R-24 roof assembly; ERC01	4.0	222	1	0%	820	1%	636	88	0	0.0%	964	16	2.0%
R-30 roof assembly; ERC02	4.0	221	2	1%	800	4%	644	87	1	1.0%	942	38	4.0%
R-40 roof assembly; ERC03	3.9	219	4	2%	780	6%	651	86	2	2.0%	920	60	6.0%
White roof; EWRF1	4.0	222	1	0%	830	0%	638	87	1	1.0%	980	0	0.0%
Low-E clear 1/ alum frame; W0601	4.1	227	(4)	-2%	810	2%	609	91	(3)	-3.0%	955	25	3.0%
Low-E tint 1/ alum frame; W0901	4.0	222	1	0%	810	2%	633	88	0	0.0%	958	22	2.0%
Low-E clear, high visible transmittance/ alum frame; W1201	4.0	222	1	0%	810	2%	637	87	1	1.0%	954	26	3.0%
Low-E tint, high visible transmittance/ alum frame; W1301	3.9	220	3	1%	810	2%	647	86	2	2.0%	955	25	3.0%
Design glazing; W6801	3.9	219	4	2%	820	1%	649	86	2	2.0%	961	19	2.0%
No Daylighting ; D3401	4.1	227	(4)	-2%	830	0%	626	89	(1)	-1.0%	980	0	0.0%
Stepped daylighting controls; D3402	4.0	221	2	1%	830	0%	634	88	0	0.0%	980	0	0.0%
Dimming daylighting controls w/ LEDs; D3403	3.8	214	9	4%	830	0%	644	86	2	2.0%	982	(2)	0.0%
Private office vacancy sensor control; LCPO8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Open office vacancy sensor control; LCOO8	4.0	221	2	1%	830	0%	634	88	0	0.0%	984	(4)	0.0%
Conference vacancy sensor control; LCCN8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Briefing/Multi-Purp/Tactical vacancy sensor control; LCCM8	4.0	223	0	0%	830	0%	631	88	0	0.0%	981	(1)	0.0%
Community room vacancy sensor control; LCCG8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
IT Equipment vacancy sensor control; LCDC8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Corridor occupancy sensor control; LCCI1	4.0	223	0	0%	830	0%	631	88	0	0.0%	981	(1)	0.0%
Corridor vacancy sensor control; LCCI8	4.0	222	1	0%	830	0%	632	88	0	0.0%	981	(1)	0.0%
Lobby occupancy sensor control; LCLO1	4.0	223	0	0%	830	0%	631	88	0	0.0%	979	1	0.0%
Lobby vacancy sensor control; LCLO8	4.0	223	0	0%	830	0%	631	88	0	0.0%	979	1	0.0%
Storage vacancy sensor control; LCST8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Mech/elec vacancy sensor control; LCME8	4.0	222	1	0%	830	0%	633	88	0	0.0%	982	(2)	0.0%
Restroom vacancy sensor control; LCRR8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Crime lab occupancy sensor control to 1/3 level; LCLB2	4.0	222	1	0%	830	0%	632	88	0	0.0%	982	(2)	0.0%
Crime lab vacancy sensor control; LCLB8	4.0	222	1	0%	830	0%	632	88	0	0.0%	984	(4)	0.0%
Exercise vacancy sensor control; LCFT8	4.0	223	0	0%	830	0%	631	88	0	0.0%	981	(1)	0.0%
Locker Room & Shower vacancy sensor control; LCLR8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Break room manual dimming; LCDN5	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Break room vacancy sensor control; LCDN8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Private Office 24/7 vacancy sensor control; LCOF8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%

City of Council Bluffs Police Headquarters

Peak Conditions

55,690 SQ.FT.

	Peak Electric				Gas		Cooling				Heating		
	Peak W/sf	Peak kW	kW Savings	% kW Savings	Peak gas KBTU/H	% peak gas savings	Cooling sf/ton	Cooling tons	Peak cooling savings	Possible cooling % downsize	Heating KBTU/H	Peak heating savings	Possible heating % downsize
Baseline; CODE1	4.0	223			830		631	88			980		
Open office 24/7 vacancy sensor control; LCOP8	4.0	222	1	0%	830	0%	631	88	0	0.0%	983	(3)	0.0%
Corridor 24/7 occupancy sensor control; LCCR1	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Corridor 24/7 vacancy sensor control; LCCR8	4.0	223	0	0%	830	0%	631	88	0	0.0%	981	(1)	0.0%
Conference 24/7 vacancy sensor control; LCCF8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Storage 24/7 vacancy sensor control; LCSR8	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Building wide 30% lower than 90.1-2010; L01BW	3.7	208	15	7%	850	-2%	653	85	3	3.0%	1,000	(20)	-2.0%
Building wide 40% lower than 90.1-2010; L02BW	3.6	202	21	9%	850	-2%	661	84	4	5.0%	1,007	(27)	-3.0%
Building wide 50% lower than 90.1-2010; L03BW	3.5	197	26	12%	860	-4%	670	83	5	6.0%	1,014	(34)	-3.0%
Air-cooled chiller, 5% decreased KW/ton; MAC01	3.9	215	8	4%	830	0%	631	88	0	0.0%	980	0	0.0%
Air-cooled chiller, 13% decreased KW/ton; MAC02	3.8	209	14	6%	830	0%	631	88	0	0.0%	980	0	0.0%
Air-cooled chiller, 20% decreased KW/ton; MAC03	3.6	203	20	9%	830	0%	631	88	0	0.0%	980	0	0.0%
Gas boiler at 85% efficiency; MHT01	4.0	223	0	0%	790	5%	631	88	0	0.0%	980	0	0.0%
Condensing gas boiler at 95% efficiency; MHT02	4.0	223	0	0%	730	12%	631	88	0	0.0%	980	0	0.0%
Water-to-water heat pump (sizing run); MPR01	4.2	233	(10)	-4%	120	86%	537	104	(16)	-18.0%	1,151	(171)	-17.0%
Water-to-water heat pump; MWW01	3.2	177	46	21%	790	5%	631	88	0	0.0%	980	0	0.0%
Exceeds Premium efficiency supply/return fan motors; MMT03	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Baseline fan system power limitation; MFD00	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Fan system power at 1.11 bhp/1000 cfm; MFD01	4.0	221	2	1%	830	0%	635	88	0	0.0%	984	(4)	0.0%
Fan system power at 0.99 bhp/1000 cfm; MFD02	3.9	218	5	2%	840	-1%	640	87	1	1.0%	987	(7)	-1.0%
Fan system power at 0.87 bhp/1000 cfm; MFD03	3.9	216	7	3%	840	-1%	644	86	2	2.0%	991	(11)	-1.0%
Exceeds Premium efficiency pump motors; MMT04	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Baseline chilled water pump system power limitation; MPC00	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Chilled water pump system power at 19.8 W/gpm; MPC01	4.0	222	1	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Chilled water pump system power at 17.6 W/gpm; MPC02	4.0	221	2	1%	830	0%	631	88	0	0.0%	980	0	0.0%
Chilled water pump system power at 15.4 W/gpm; MPC03	4.0	220	3	1%	830	0%	631	88	0	0.0%	980	0	0.0%
Chilled water pump system power at 21.9 W/gpm; MPC04	3.9	218	5	2%	830	0%	631	88	0	0.0%	980	0	0.0%
Baseline hot water pump system power limitation; MPH00	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Hot water pump system power at 17.1 W/gpm; MPH01	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Hot water pump system power at 15.2 W/gpm; MPH02	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
Hot water pump system power at 13.3 W/gpm; MPH03	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
VFD on heating pump; MPP01	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
VFD on cooling pump; MPP02	3.9	216	7	3%	830	0%	631	88	0	0.0%	980	0	0.0%
Boiler pump head pressure reset control; MPP03	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
CO2 control of outside air; MOA02	3.8	212	11	5%	770	7%	720	77	11	13.0%	905	75	8.0%
Carbon monoxide sensor control of garage vent fans; MOA22	4.0	223	0	0%	800	4%	631	88	0	0.0%	943	37	4.0%
Total heat recovery; MHRT1	3.8	212	11	5%	720	13%	730	76	12	14.0%	851	129	13.0%
85% service water heating efficiency; MHW01	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
90% service water heating efficiency; MHW02	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%
95% service water heating efficiency; MHW03	4.0	223	0	0%	830	0%	631	88	0	0.0%	980	0	0.0%

City of Council Bluffs Police Headquarters

Annual Energy by Fuel Source

55,690 SQ.FT.

	Annual Energy			Annual Electric			Annual Gas		
	MMBTU (incl. electric)	MMBTU Savings	% Savings	kWh	kWh Savings	% kWh Savings	Gas MMBTU	Gas MMBTU Savings	% Gas Savings
Baseline; CODE1	4,188			1,065,796			552.3		
Utility Protocol Baseline; UTL01	3,885			1,015,835			419.8		
Bundle 1; BND01	2,396	1,490	38%	626,470	389,365	38%	257.5	162.3	39%
Bundle 2; BND02	2,118	1,767	45%	563,180	452,655	45%	196.0	223.8	53%
Bundle 3; BND03	2,008	1,877	48%	526,400	489,435	48%	211.6	208.2	50%
R-16 wall assembly; EWC01	4,089	100	2%	1,060,931	4,865	0%	469.2	83.1	15%
R-20 wall assembly; EWC02	4,044	145	3%	1,057,698	8,098	1%	435.7	116.6	21%
R-24 roof assembly; ERC01	4,151	37	1%	1,064,263	1,533	0%	520.6	31.7	6%
R-30 roof assembly; ERC02	4,101	87	2%	1,062,754	3,042	0%	475.8	76.5	14%
R-40 roof assembly; ERC03	4,057	132	3%	1,060,231	5,565	1%	439.4	112.9	20%
White roof; EWRF1	4,202	(14)	0%	1,067,714	(1,918)	0%	559.3	-7.0	-1%
Low-E clear 1/ alum frame; W0601	4,046	143	3%	1,047,921	17,875	2%	470.1	82.2	15%
Low-E tint 1/ alum frame; W0901	4,107	81	2%	1,057,786	8,010	1%	498.1	54.2	10%
Low-E clear, high visible transmittance/ alum frame; W1201	4,103	86	2%	1,057,920	7,876	1%	493.3	59.0	11%
Low-E tint, high visible transmittance/ alum frame; W1301	4,136	53	1%	1,063,555	2,241	0%	507.1	45.2	8%
Design glazing; W6801	4,167	21	1%	1,067,420	(1,624)	0%	525.6	26.7	5%
No Daylighting ; D3401	4,201	(13)	0%	1,071,328	(5,532)	-1%	546.4	5.9	1%
Stepped daylighting controls; D3402	4,180	9	0%	1,062,350	3,446	0%	555.1	-2.8	-1%
Dimming daylighting controls w/ LEDs; D3403	4,135	54	1%	1,046,189	19,607	2%	565.5	-13.2	-2%
Private office vacancy sensor control; LCPO8	4,187	1	0%	1,065,100	696	0%	553.5	-1.2	0%
Open office vacancy sensor control; LCOO8	4,168	21	0%	1,053,807	11,989	1%	572.4	-20.1	-4%
Conference vacancy sensor control; LCCN8	4,188	1	0%	1,065,541	255	0%	552.7	-0.4	0%
Briefing/Multi-Purp/Tactical vacancy sensor control; LCCM8	4,184	4	0%	1,064,772	1,024	0%	551.5	0.8	0%
Community room vacancy sensor control; LCCG8	4,188	1	0%	1,065,616	180	0%	552.4	-0.1	0%
IT Equipment vacancy sensor control; LCDC8	4,182	7	0%	1,063,818	1,978	0%	552.3	0.0	0%
Corridor occupancy sensor control; LCCI1	4,188	1	0%	1,065,254	542	0%	553.3	-1.0	0%
Corridor vacancy sensor control; LCCI8	4,187	1	0%	1,064,861	935	0%	554.1	-1.8	0%
Lobby occupancy sensor control; LCLO1	4,118	71	2%	1,051,245	14,551	1%	531.6	20.7	4%
Lobby vacancy sensor control; LCLO8	4,089	99	2%	1,049,016	16,780	2%	510.7	41.6	8%
Storage vacancy sensor control; LCST8	4,187	1	0%	1,065,144	652	0%	553.8	-1.5	0%
Mech/elec vacancy sensor control; LCME8	4,185	4	0%	1,061,109	4,687	0%	563.9	-11.6	-2%
Restroom vacancy sensor control; LCRR8	4,188	1	0%	1,065,563	233	0%	552.4	-0.1	0%
Crime lab occupancy sensor control to 1/3 level; LCLB2	4,177	11	0%	1,062,185	3,611	0%	553.2	-0.9	0%
Crime lab vacancy sensor control; LCLB8	4,174	14	0%	1,061,068	4,728	0%	553.9	-1.6	0%
Exercise vacancy sensor control; LCFT8	4,187	1	0%	1,064,772	1,024	0%	554.1	-1.8	0%
Locker Room & Shower vacancy sensor control; LCLR8	4,187	1	0%	1,065,173	623	0%	553.2	-0.9	0%
Break room manual dimming; LCDN5	4,168	20	0%	1,065,376	420	0%	533.7	18.6	3%
Break room vacancy sensor control; LCDN8	4,170	18	0%	1,064,796	1,000	0%	537.4	14.9	3%
Private Office 24/7 vacancy sensor control; LCOF8	4,188	1	0%	1,065,324	472	0%	553.0	-0.7	0%

City of Council Bluffs Police Headquarters

Annual Energy by Fuel Source

55,690 SQ.FT.

	Annual Energy			Annual Electric			Annual Gas		
	MMBTU (incl. electric)	MMBTU Savings	% Savings	kWh	kWh Savings	% kWh Savings	Gas MMBTU	Gas MMBTU Savings	% Gas Savings
Baseline; CODE1	4,188			1,065,796			552.3		
Open office 24/7 vacancy sensor control; LCOP8	4,133	55	1%	1,046,918	18,878	2%	561.1	-8.8	-2%
Corridor 24/7 occupancy sensor control; LCCR1	4,188	0	0%	1,065,393	403	0%	553.4	-1.1	0%
Corridor 24/7 vacancy sensor control; LCCR8	4,189	(0)	0%	1,065,257	539	0%	553.9	-1.6	0%
Conference 24/7 vacancy sensor control; LCCF8	4,188	0	0%	1,065,666	130	0%	552.3	0.0	0%
Storage 24/7 vacancy sensor control; LCSR8	4,188	0	0%	1,065,780	16	0%	552.3	0.0	0%
Building wide 30% lower than 90.1-2010; L01BW	3,910	279	7%	990,564	75,232	7%	529.9	22.4	4%
Building wide 40% lower than 90.1-2010; L02BW	3,816	372	9%	965,473	100,323	9%	521.9	30.4	6%
Building wide 50% lower than 90.1-2010; L03BW	3,730	459	11%	941,084	124,712	12%	519.4	32.9	6%
Air-cooled chiller, 5% decreased KW/ton; MAC01	4,146	42	1%	1,053,364	12,432	1%	552.3	0.0	0%
Air-cooled chiller, 13% decreased KW/ton; MAC02	4,145	44	1%	1,053,014	12,782	1%	552.3	0.0	0%
Air-cooled chiller, 20% decreased KW/ton; MAC03	4,143	46	1%	1,052,318	13,478	1%	552.3	0.0	0%
Gas boiler at 85% efficiency; MHT01	4,166	22	1%	1,065,797	(1)	0%	530.4	21.9	4%
Condensing gas boiler at 95% efficiency; MHT02	4,128	60	1%	1,064,901	895	0%	495.3	57.0	10%
Water-to-water heat pump (sizing run); MPR01	4,086	102	2%	1,143,957	(78,161)	-7%	183.1	369.2	67%
Water-to-water heat pump; MWW01	3,093	1,095	26%	751,476	314,320	29%	529.6	22.7	4%
Exceeds Premium efficiency supply/return fan motors; MMT03	4,186	2	0%	1,065,111	685	0%	552.7	-0.4	0%
Baseline fan system power limitation; MFD00	4,188	0	0%	1,065,796	0	0%	552.3	0.0	0%
Fan system power at 1.11 bhp/1000 cfm; MFD01	4,160	28	1%	1,056,892	8,904	1%	554.2	-1.9	0%
Fan system power at 0.99 bhp/1000 cfm; MFD02	4,132	57	1%	1,047,362	18,434	2%	558.7	-6.4	-1%
Fan system power at 0.87 bhp/1000 cfm; MFD03	4,103	85	2%	1,038,711	27,085	3%	559.4	-7.1	-1%
Exceeds Premium efficiency pump motors; MMT04	4,188	1	0%	1,065,649	147	0%	552.3	0.0	0%
Baseline chilled water pump system power limitation; MPC00	4,188	0	0%	1,065,796	0	0%	552.3	0.0	0%
Chilled water pump system power at 19.8 W/gpm; MPC01	4,180	8	0%	1,063,376	2,420	0%	552.3	0.0	0%
Chilled water pump system power at 17.6 W/gpm; MPC02	4,172	16	0%	1,061,015	4,781	0%	552.3	0.0	0%
Chilled water pump system power at 15.4 W/gpm; MPC03	4,164	25	1%	1,058,591	7,205	1%	552.3	0.0	0%
Chilled water pump system power at 21.9 W/gpm; MPC04	4,147	42	1%	1,053,575	12,221	1%	552.3	0.0	0%
Baseline hot water pump system power limitation; MPH00	4,188	0	0%	1,065,796	0	0%	552.3	0.0	0%
Hot water pump system power at 17.1 W/gpm; MPH01	4,188	0	0%	1,065,759	37	0%	552.3	0.0	0%
Hot water pump system power at 15.2 W/gpm; MPH02	4,188	0	0%	1,065,652	144	0%	552.7	-0.4	0%
Hot water pump system power at 13.3 W/gpm; MPH03	4,188	0	0%	1,065,473	323	0%	553.3	-1.0	0%
VFD on heating pump; MPP01	4,188	0	0%	1,065,667	129	0%	552.7	-0.4	0%
VFD on cooling pump; MPP02	4,125	63	2%	1,047,287	18,509	2%	552.3	0.0	0%
Boiler pump head pressure reset control; MPP03	4,188	0	0%	1,065,667	129	0%	552.7	-0.4	0%
CO2 control of outside air; MOA02	4,064	124	3%	1,050,494	15,302	1%	479.9	72.4	13%
Carbon monoxide sensor control of garage vent fans; MOA22	4,152	36	1%	1,061,563	4,233	0%	530.3	22.0	4%
Total heat recovery; MHRT1	4,090	98	2%	1,054,325	11,471	1%	493.2	59.1	11%
85% service water heating efficiency; MHW01	4,186	2	0%	1,065,796	0	0%	550.0	2.3	0%
90% service water heating efficiency; MHW02	4,184	4	0%	1,065,796	0	0%	547.9	4.4	1%
95% service water heating efficiency; MHW03	4,175	13	0%	1,065,796	0	0%	538.5	13.8	2%

Appendix D. Project Participants

Name	Company	Email	Phone
Amber Buckingham	Black Hills Energy	amber.buckingham@blackhillscorp.com	515-343-2021
Scott Milner	City of Council Bluffs	samilner@councilbluffs-ia.gov	913-307-3700
Chris Birkenmaier	Hoefer Wysocki Architects LLC	chris.birkenmaier@hoeferwysocki.com	913-307-3700
Trudy Johannsen	MidAmerican Energy Company	tljohannsen@midamerican.com	712-366-5659
Misty Miller	MidAmerican Energy Company	MDMiller@midamerican.com	712-366-5659
Amber Moser	MidAmerican Energy Company	ALMoser@midamerican.com	563-333-8049
Brad Carne	Specialized Engineering Solutions	bcarne@specializedeng.com	402-991-5520
Jamie Van Roy	Specialized Engineering Solutions	jvanroy@specializedeng.com	402-991-5520
Alison Decker	The Weidt Group	alisond@twgi.com	952-938-1588
Vinay Ghatti	The Weidt Group	vinayg@twgi.com	952-938-1588